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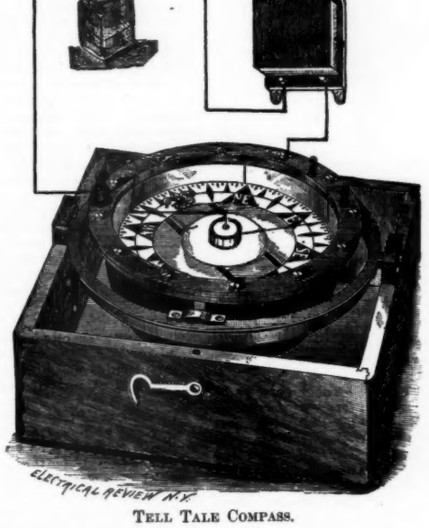
Tell-Tale Compass.

In the accompanying engraving is illustrated an interesting device, designed by Mr. P. D. Richards, of West Medford, Mass., for giving an alarm when a vessel shifts from its course. This is done by ringing an electric bell, which can be placed in the captain's room or elsewhere. As will be understood from the diagram, the compass card carries a light wire electrically connected to a metallic cup at the center containing a few drops of mercury. This wire is bent over the edge of the compass, and as long as the ship maintains its course, remains out of contact with either of two metallic stops placed at a certain angular distance on either side of the bent end of the wire. These stops are set into holes in the periphery of the compass and may be adjusted to any desired circumferential position to correspond to the position of the compass needle when the vessel is following the designed course. Into the mercury vessel dips the tip of a wire, permanently secured to a binding post, which leads to a battery, including, in its circuit, an electric bell, the binding post being insulated from the rim of the compass, and the return wire from the bell being secured to said rim; thus, when the vessel deviates from its course to a determinate extent, the wire fixed to the card is brought into contact with one or the other of the stops and closes the circuit and rings the bell, notifying the captain. It is stated by those who know that the device is thoroughly practicable and highly useful.



TELL TALE COMPASS.

Diameter of a Thunderbolt.

"Did you ever see the diameter of a lightning flash measured?" asked a geologist. "Well, here is the case which once inclosed a flash of lightning, fitting it exactly, so that you can see just how big it was. This is called a 'fulgurite,' or 'lightning-hole,' and the material it is made of is glass. I will tell you how it was manufactured, though it took only a fraction of a second to turn it out.

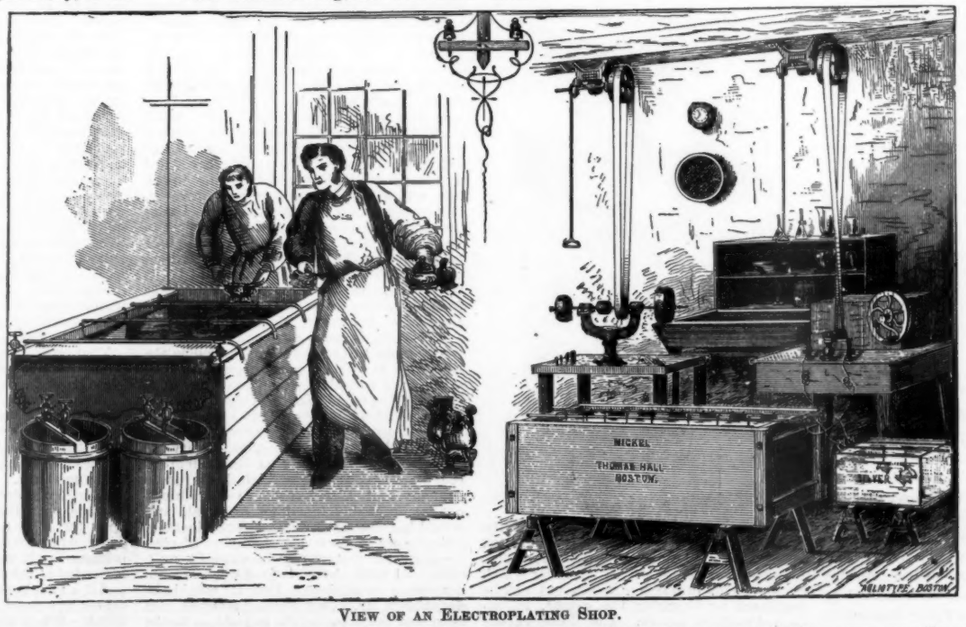
"When a bolt of lightning strikes a bed of sand, it plunges downward into the sand for a distance less or greater, transforming simultaneously into glass the silica in the material through which it passes. Thus, by its great heat, it forms at once a glass tube of precisely its own size. Now and then such a tube, known as a 'fulgurite,' is found and dug up. Fulgurites have been followed into the sand by excavation for nearly 30 feet. They vary in interior diameter from the size of a quill to three inches or more, according to the 'bore' of the flash.

"But fulgurites are not alone produced in sand; they are found also in solid rock, though very naturally of slight depth and frequently existing merely as a thin glassy coating on the surface. Such fulgurites occur in astonishing abundance on the summit of Little Ararat, in Armenia. The rock is soft and so porous that blocks a foot long can be obtained, perforated in all directions by little tubes filled with bottle green glass formed from the fused rock. There is a small specimen in the National Museum which has the appearance of having been bored by the toredo, the holes made by the worm subsequently filled with glass.

"Some wonderful fulgurites were found by Humboldt on the high Nevada de Toluca, in Mexico. Masses of the rock were covered with a thin layer of green glass. Its peculiar shimmer in the sun led Humboldt to ascend the precipitous peak at the risk of his life."—*Washington Star.*

An Electroplating Shop.

The illustration below represents the interior of an electroplating shop as equipped by Thomas Hall, 19 Bromfield street, Boston. Mr. Hall makes a specialty of such installations and has equipped a number of large and successful plants of this character.



VIEW OF AN ELECTROPLATING SHOP.

*** Counsel for the government in the case against the American Bell Telephone Company, in Boston, has been given three months' extension of time in which to introduce testimony before the examiner appointed by the United States District Court.

A Note on Some Dangers in Electric Lighting.

BY WM. McDEVITT, READ AT THE MEETING OF THE ELECTRICAL SECTION, FRANKLIN INSTITUTE, FEBRUARY 24, 1891.

After several years of experience in noting the dangers occurring in the use of electric lighting, it has been clearly demonstrated that in nearly every case the accidents resulted through ignorance both on the part of the workmen engaged in installing the wires and the lessee to whose care the new apparatus was entrusted.

These practical illustrations served as valuable lessons to those who witnessed them, more especially to the workmen, whose education in the business consisted merely in following plans laid out by the contractor.

Although the introduction of electric lighting has rapidly increased in our city, its use has been comparatively free from accidents, proving that most of the inherent dangers have been controlled, leaving but few features that require the attention of inventive minds to overcome. The most important of the existing defects is that relating to fusible connections, as the innumerable variety of alloys used for fuse metal is very misleading, and is still an element of danger. Some of these compositions possess the properties of good electrical conductivity and are slow to heat; other compositions are of a character exhibiting weakness when heated, resulting in annoyance from continuous breaks and offering temptations (as has been found) to use ordinary wire in the absence of proper fuses.

Another universal danger in electric lighting results from the want of some uniform or more ready method of perfecting splices or joints in conductors. Some workmen are in the habit of making loose copper unions, leaving the solidity of the joint dependent on solder, which, being a metallic cement, is liable to be fused by a possible heavy short circuit occurring on the line, thus melting the solder and leaving a loose connection.

Probably the most alarming danger exists through the possibility of lightning being conducted into houses lighted by electricity where the latter is supplied by aerial wires. The existence of this danger has been demonstrated where the house wires are attached to gas fixtures, offering a ready path for the lightning, which, in leaping from the charged wires to the gas pipes, carries the electric light current across, forming an arc, which pierces the pipe, and where gas is present, it will be ignited, causing a steady blaze. If this accident should occur near the ceiling, the building would be endangered.

With the rapid introduction of new appliances in electrical science, it may reasonably be expected that the defects above mentioned will be overcome in the near future.

THE PROPHET'S COLUMN.

Last week, by a few misplaced letters, the hypocritical Pharisee was made to appear as worshipping the sun. This is not fair to the intelligent and refined Parsee of India, who is the real sun worshipper, and whose veneration for the sun has, to say the least, a semblance of justification.

What would we do without the sun?

The late Daniel Pratt, that peripatetic philosopher whose eccentricities have amused generations of college students, once addressed a room full of freshmen in Holworthy to prove that the sun was worth three trillion of dollars a year to us.

Just how Daniel made his quantitative determination of the sun's value does not appear, but our condition, were we deprived of the sun's rays, furnishes a most instructive speculation.

What would then be our source of electricity?

Not in coal, for coal is but stored up sunshine.

Geology tells us that coal beds are the remains of forests of past ages, and forests could not exist without the light and heat of the sun.

Wind power and waterfalls naturally come to mind, but there would be no wind, because wind is due to the unequal heating of the earth's atmosphere by the sun; and there would be no rivers, for they are produced by rain and snow, which result from the evaporation of water by the sun.

There would be just two sources of electricity left, one being the energy resulting from such uncombined chemicals as may be found to exist on the earth, and the other would be the power of the ebb and flow of the tides which are due to gravity.

Even here the effect of the sun is perceptible, although in this case it is the gravity of the sun and not its rays.

Nearly all of the energy on earth has come as sunlight.

The tremendous torrent of Niagara and the Summer shower, the glaciers of the Alps and the crystal snowflake, are alike the work of the sunbeam.

Whether a ship moves by wind or by steam, it matters not. They are both propelled by the sun.

How, then, does this wonderful power get from the sun to earth?

What kind of a conductor is it that carries untold horse-power through millions of miles?

Modern science tells us that there must be a conductor of some kind, and has postulated a medium called ether.

The ether is the Africa of Science, and not all of the gold and ivory of the Dark Continent would equal the rewards which await its successful explorers.

But what has this to do with the future of electricity? Is the ether also the medium concerned in the transmission of electricity?

We shall see.

THE PROPHET.

New York Board of Electrical Control.

A meeting of the board was held at the Mayor's office, March 30. It was expected that ex-Judge Kelly would prove the charges he had made against Chief Engineer Kearney at a previous meeting. Judge Kelly said that his remarks were complaints, not charges, which disappointed the spectators. Expert Wheeler was then questioned concerning housetop wires which have been ordered removed. The Mayor had a list of these wires. Public Works Commissioner Gilroy was ordered to remove all the wires on the list. The order of December providing for the removal of all wires and poles between Eighth and Fifty-ninth streets was modified so as to give several companies more time.

The Westinghouse Automatic Circuit Breaker.

Street railway men who have used in their stations the ordinary fusible block, and the make-and-break switch, know how difficult it is to keep their switchboards looking well, especially when they have had a number of short circuits on the line. Not only are the safety fuse blocks burned and discolored, but also the portion of the switchboard near the safety fuse is injured, and in addition to the above, the jaws of the switch are sometimes partly melted or fused, and the whole presents anything but a neat appearance. In order to avoid this, the Westinghouse Electric and Manufacturing

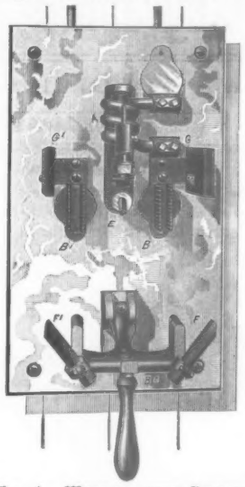


FIG. 1.—WESTINGHOUSE CIRCUIT BREAKER.—OPEN.

Company have devised an automatic circuit breaker, which breaks the current automatically whenever there is a short circuit on the line, without burning or in any way disfiguring the breaker itself. It has been tested on as high a current as 900 amperes and 500 volts, or a total of 450,000 watts, without in any way affecting or burning the breaker.

In the accompanying cuts, Fig. 1 is a view of the breaker when open and Fig. 2 represents it closed.

The automatic circuit breaker consists of an electro-magnet, A, in series with a double break switch—B, B^1 and B^2. If a short circuit occurs in the line, the electro-magnet will attract its armature, C, and with it the trigger, D, which holds the switch closed, and thereby allows the spring, E, to throw the lever arm out of the contacts. This, however, does not yet open the circuit as the carbon contacts, F and F^1, carried by the lever arm still touch the carbon plates, G and G^1, at the sides of the switch, and at these carbon points the circuit is finally

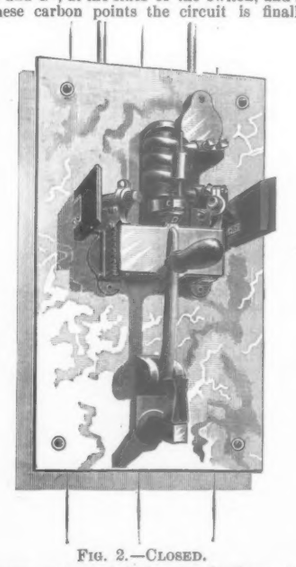


FIG. 2.—CLOSED.

broken without injuring in the least the metal parts of the switch. The feeder switch should always be opened before the circuit breaker is closed again. The point at which these circuit breakers will cut out can be regulated by changing the weight, H, attached to the armature. The Westinghouse Electric and Manufacturing Company make two styles of circuit breakers, one to work on feeders up to 400 amperes capacity (type A) and one to work on feeders from 400 amperes to 800 amperes capacity (type B). These can be used in connection with any street railway system.

INDUCTION.

MR. J. J. CARTY'S PAPER ON "INDUCTIVE DISTURBANCES IN TELEPHONE CIRCUITS" DISCUSSED AT LENGTH.

We published March 28 Mr. J. J. Carty's paper on the above subject, which was read before the Institute of Electrical Engineers, March 17. We publish below the discussion which followed:

The President: Discussion of the paper is now in order. The discussion will be opened by Mr. Kennelly.

Mr. A. E. Kennelly: The very interesting experiments we have just heard described can leave no doubts in the minds of any of us that electrostatic induction has a very important influence in disturbance between parallel telephonic lines, and assuming that the experiments are truly represented—and I am far from desiring to impugn them—there can be no question that electrostatic capacity is chargeable with all, or nearly all, the disturbance that was occasioned in them under those conditions. But the general question of mutual disturbance between telegraphic or telephonic conductors is a very broad and a very vexed one. If two wires run parallel to each other and current flow through one, we must have electro-magnetic disturbance. This was one of Faraday's original experiments—and we must also have electrostatic disturbance. The question is whether we are entitled to calculate upon what proportion of the disturbance is due to one and what to the other. In this case, as in so many others, the question of jurisdiction arises. It is sometimes asked have we sufficient knowledge of the laws of nature in this particular instance to rely upon the results of calculation, and the answer is, apparently, that we have. Because, however limited our knowledge of the laws of nature may be, it seems to be, in this instance, sufficiently perfect to answer the purposes of the inquiry. Just as when we let a stone fall to the ground, if any one were to ask us if we had the right to predict by calculation what the result of that fall would be, we could say that to a certain degree of accuracy we could certainly do so by treating the stone as a rigid body, and the laws of rigid bodies are simple and comparatively well understood. But if we had to undertake to say exactly what the conditions would be, then we should have to come to the molecule, and our knowledge of the molecule is at present unfortunately rather indefinite.

The theory of this subject has been treated by several writers, from time to time, and particularly it has been very ably treated by Oliver Heaviside in the journal of the Society of Electrical Engineers, of London, in the February number, 1881.

I have endeavored to obtain some quantitative notion of how much electrostatic disturbance and how much electro magnetic disturbance would take place in Mr. Carty's Fig. 2, by assuming certain definite quantitative relations between those circuits. We suppose that L^1 and L^2 are half an inch apart, and all wires are No. 12 B & S gauge copper, also that L^3 is so far remote that its inductive influence on the others and the influence of the others upon it may be omitted from the calculation. Then it is easy to find out how much electrostatic induction there would be, supposing electromagnetic action absent, and how much electro-magnetic action takes place between the two, supposing electrostatic disturbance did not take place. To avoid very great complexities which would take long to follow out to their ultimate consequences, that, perhaps, is a fair comparison. Under those circumstances, supposing that electrostatic influence existed alone, with four telephones in the secondary circuit, whose resistance, we might suppose, would be 75 ohms each, and whose inductance might be 90 milli-henrys apiece, then if the primary circuit had a periodic electromotive force acting upon it, such as would correspond for example to the note A sounded in the telephone at 400 or, more accurately, 435 periods per second, it would be necessary to insert an impedance in the primary circuit equal to 400 ohms in order to have electromagnetic action equal to electrostatic action. The fact Mr. Carty has mentioned, that the impedance of the receiving instrument of the primary circuit was high, leads us to suppose that this impedance was much greater, probably ten times as great, and would bear out his statement from the theoretical point of view that the effect of electro-magnetic disturbance is virtually null, compared with electrostatic disturbance under those conditions. But it would be desirable if Mr. Carty could give us an idea as to how far reducing the impedance in the receiving end disturbed the neutral point and so gave indications of a tendency to equality between the two disturbances.

Of course, the rough calculation that I have just presented deals with the subject, ignoring entirely all those waves and oscillations which we know must inevitably pursue their path in primary circuits upon any change of current. We are all familiar with the simple and very interesting experiment of taking the ropes from a flagstaff, say, or the halyards of a mast when they are tolerably heavy—taking them in the hand and giving them a jerk. Of course, the ultimate tendency of the displacement of the ends held in the hand would be to cause the rope to assume a slightly different catenary, but the immediate consequence is that a wave travels up the rope, reaches the top, is reflected back and again comes to the hand, subsiding gradually all the time. It may even be sufficiently strong to leave the hand again and repeat its course back to the top. But that represents very faithfully the motion that takes places in any electric circuit when the primary electromotive force is impressed upon it. No matter what the conditions may be of electrostatic induction or electro-magnetic induction, so long as both are present no current can be started in the wire, with any finite change of electromotive force, without setting up an oscillation or a wave in that circuit, and those waves run to the end of the circuit if they be not absorbed in the passage, and recoil in the same way that those waves in the rope do. So that if we consider what takes place in any circuit we have to imagine a vast succession of waves which travel one after another, but whose rapidity is so great that they entirely subside within a few hundredths, at the most, and very often within a few millionths of a second. In the case of Mr. Carty's experiments, they probably would not last more than a few millionths of a second. There can be no doubt that those waves are there, and even supposing that the mathematical basis on which they rest were entirely destroyed by some fresh discovery, the researches of Hertz have placed those waves on a firm basis. Those oscillations of flow would not probably be a leading factor in this particular instance, but their existence must not be forgotten.

Finally, I think we are much indebted to Mr. Carty for giving us such a clear, succinct and interesting account of experiments which have undoubtedly proved the very great influence of electrostatic induction in the particular case he gives us. I only hope that before closing the paper he will place some more quantitative statements upon the record, by which we shall be able to have a more clear and accurate account of the exact condition of the circuits he experimented upon, and by which we may be able either to check fallacy, to advance theory, or to improve practice.

Mr. Carty: I go so far as to set forth that the effect of the electro magnetic induction between parallel telephone wires may be neglected. That is, that when a man is talking on one wire and his speech is heard by induction on a parallel wire, that that speech finds its way between the two wires by virtue of electrostatic induction, and that electro-magnetic induction is entirely negligible. I would like to describe a few experiments to prove that; and if they do not prove it, I shall be very glad to have that fact pointed out.

I will now show what I consider the most favorable condition for creating electromagnetic induction between two telephone wires. That (indicating T, Fig. 12) represents the coil of a long distance transmitter sending the most powerful telephone current that it is now possible to generate. L^1 represents the wire connected to earth. It may be, we will say, 200 feet long. Parallel to it and an eighth of an inch away, we will place another telephone circuit. These wires may have an insulation of 10,000 megohms and the resistance might be considered as one ohm. Now, a current resulting from a given note in the transmitter through the wire (L^1) produces a series of changes in the magnetic field surrounding it, and that action is roughly explained by assuming that the current starting in L^1 induces a current in L^2 in the opposite direction, and that the induced current will flow through both telephones *a* and *b*. Now, it is a fact that under those conditions, absolutely no sound is heard in the telephones *a* or *b*.

That represents the strongest current that it is possible to produce by that transmitter—the strongest changes—and consequently we should have the greatest fluctuation in the magnetic field surrounding the wire (L^1), but under those circumstances there is absolutely no disturbance whatever effected in the telephones *a* or *b* located in L^2. That, I think, is a crucial test.

Now, I will describe an experiment which I made with those same wires. We will open the wire L^1 (Fig. 13) at the far end. Then, when the transmitter is operated, noise is immediately heard at the telephones *a* and *b*, located at the ends of the secondary wire, and if a telephone, *c*, be located at the exact center of impedance it will be found to be silent. When the wire L^1 is opened at the far end we have the maximum electrostatic and the minimum electro-magnetic action; when it is closed we have the maximum electro-magnetic action and the minimum electrostatic action. The reason that the electrostatic action is slight in Fig. 12 can be seen from Fig. 14. Assuming that the *m n*

represents the height of potential of the transmitter; the resistance of the circuit is mostly in the transmitter and the fall of potential therein is very sudden. At any point along the wire L^1 the potential would be practically zero, as shown by the dotted line $o\,p$.

If there is any fallacy in these experiments, I should be very glad to have it pointed out, and if it is admitted that electro-magnetic induction is negligible between actual telephone circuits, why, I should be glad to have that come out also.

The President: The paper is now open for general discussion. We would be glad to hear remarks from any one.

I should like to ask Mr. Carty in regard to this arrangement. He has represented both of those lines as grounded. Why is it not in that case equivalent to connecting the two lines together? In other words, if both lines are grounded, why isn't that a complete metallic circuit?

Mr. Carty: Well, I think Ohm's law will let us out of that. We have both wires connected together by a conductor of zero resistance, and any current generated in this circuit has two paths back to here—one path through the earth, which is zero, and one path through the line, which is of considerable resistance.

The President: Do I understand that you consider the earth as a zero resistance in comparison with the 200 feet of wire?

Mr. Carty: I have assumed that we have

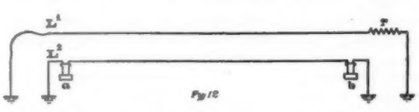


Fig 12

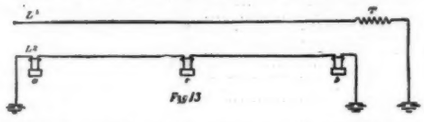


Fig 13

a zero resistance in the earth, and, as a matter of fact, the experiment, as I have repeatedly tried it, was made, using the same earth connection. In an experiment in this room you would probably connect through the water pipe, or there could be a return wire put in there—in that condition, that resistance is zero. As a matter of common practice, if those wires were separated, and you talked on them, there would be no interference between them due to earth leakage.

I wish to show another experiment in proof of the fact, or what I think is a fact, that electro-magnetic induction is negligible when we consider the action that goes on between two telephone circuits. I expressly limit the statement to the action between telephone circuits, and I am not discussing disturbances in general, but merely inductive cross talk. Now, I will draw a line, L^2 (Fig. 15), similar to the one I used before, and we will assume that the circuit is completed by a return wire of no resistance, or of very low resistance, entirely outside of the field of disturbance, so as to eliminate all questions of leakage through the earth. We will say that L^1 is grounded on a gas pipe. We then have the disturbing wire as before, and when the transmitter is operated loud tones are heard at the end telephones, a and b, thus: If this were entirely due to the creation of an electro-magnetic field around the disturbing wire, the effect

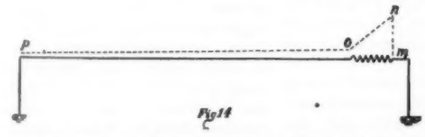


Fig 14

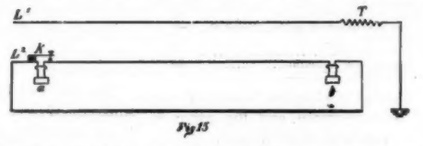


Fig 15

on the secondary wire would be increased by short-circuiting one of the telephones by the key k. Now, it is found that when this is done, instead of increasing the sound in the other telephone, it absolutely removes it. Now, the case just described is another condition where you should get an increase of electro-magnetic action, if the disturbance is due to the magnetic field, but the noise, instead of increasing, disappears entirely. Now, you will see how beautifully the thing may be explained by assuming that the disturbance is due to direct electrostatic action. In this case we will say that the wire L^1, at a given instant, has a plus charge upon it which induces a minus charge on L^2. Now, when the inducing charge is removed the induced charge divides and flows away at both ends. But as there is a great deal of resistance in telephone b, and practically no resistance in key k, the charge and discharge of L^2 takes place up and down through the key end and none of it goes through the telephone b. Now, I think that is a complete refutation of the statement that any portion of the noise produced in the telephone is due to electro-magnetic action. There is no doubt about it that when the current is going through L^1, in the act of charging it, that there is a magnetic field surrounding that current, but I have shown that it is so feeble that it does not produce any effect in the telephone; that is, the action that is due to the electro-magnetic field is so feeble that the ear is not able to tell whether it is present or not.

Mr. George B. Prescott, Jr.: With reference to the first diagram, I would like to ask Mr. Carty if he tried the simple experiment of interrupting a battery current in the inducing circuit by means of an ordinary telegraph key?

Mr. Carty: I am very glad that Mr. Prescott brought that up. I have an experiment that furnishes a very good illustration of how electro-magnetic action works. I did not try it with an ordinary telegraph key, but I sent through a powerful current so as to get an electro-magnetic field with which I could deal. Now, in this case T (Fig. 12) represents (indicating) a vibrator connected with a large battery. We had a very powerful current flowing through that wire, L^1. The current was constantly vibrating, and it was a very strong current, indeed. Now, in that case I used the same secondary wire, and a telephone in the center, and then we found a noise in all three telephones, just exactly what you should expect in dealing with electro-magnetic induction. You would expect to find a current at a given instant, with very slight differences, constant in all parts of the circuit; that is, you would expect to find as much noise at the center telephone as at the end telephone. You would expect that if this middle telephone were short-circuited the noise would be increased at the end telephones, and then you would further expect that if one end telephone were short-circuited that the remaining one would be still louder. That was the case. Now, consider the circuit with the middle telepone cut out and one end telephone cut out, and the other end telephone giving a loud noise, with a strong current in L^1; but with the strongest telephone current we could produce in L^1, there was no noise there at all. And further than that, the methods of every-day practice have been changed to meet these views, and our predictions and calculations, based on this way of working, are invariably correct. All of our cables, which are twisted in pairs are subjected to a very rigid cross-talk test, and some of the refinements which have, to be taken into consideration in making those tests are certainly most surprising.

These experiments were begun at Washington, I think, more than two years ago. They have been in the files of various companies and have been reported on by different people, and a good many of them have been in the Patent Office, and some of them are still in the Patent Office, and if there is a fallacy in the reasoning, I am very anxious to find it out, because I have undertaken to point out an error in three authorities to-night, and I would like to withdraw my statements if they are wrong.

Mr. Prescott: Mr. Carty admits that interrupted direct currents in the inducing circuit caused electro-magnetic disturbances in the telephone wire. Does not, therefore, his first experiment only indicate that the effects of electro-magnetic induction are slight in the case of feeble, rapidly alternating currents, that is telephonic currents?

Mr. Carty: I mean that with the most powerful telephone transmitters in use, with the most powerful telephone currents which I have generated in practice, that the effect of electro magnetic induction is negligible, but that if it were possible to increase the strength of the current I am not prepared to say that electro-magnetic induction would not then become a factor. All that I am saying is that for the present it is negligible.

Dr. Louis Bell: I think it is a pretty clear case that it takes a good deal stronger current than one would at first suppose to act inductively. I would like, as a matter of curiosity, to ask Mr. Carty if he knows what the numerical coefficient is of self-induction for one of those long distance transmitters and about what is the largest current that is used in practice? I ask this, simply because it may facilitate computation of the possible effect if one should care to try it. In the case of interference between one telephone circuit and another, I think that unless the lines were most unreasonably close together that the ordinary magnitude of the current employed would not be sufficient to cause disturbance. I have worked it out roughly for heavier currents and the electro-magnetic effect is not nearly so great as one would suppose.

Mr. Carty: I have not the figures in mind, but that matter was investigated by Professor Cross, and he published a paper which can be easily found. I have no figures as to the transmitter coil. I think somewhere in Mr. Kennelly's paper he gives what the inductance of the long distance transmitter coil is. I do not remember what it is myself.

Mr. Kennelly: Will Mr. Carty please give us the resistance for that?

Mr. Carty: 160 ohms is the resistance.

Mr. Kennelly: In that case I beg to point out that the impedance of that would be very considerable, and probably the position Mr. Carty takes is correct. If Mr. Carty can give us some direct experiments made when that impedance is diminished or annulled, we can then point out where the magnetic effect will become visible.

Mr. Carty: I did not quite get what Mr. Kennelly said.

Mr. Kennelly: If Mr. Carty could give us some experiments in which the impedance in the transmitter was very small we could then readily find at what point the electro-magnetic disturbances would become of considerable magnitude compared with electro-static disturbance.

Mr. Carty: That would be a question affecting the strength of the primary current, would it?

Mr. Kennelly: The degree of variation of it, or both—the rate of changing.

Mr. Carty: Well, I have not the figures, but I produced electro-magnetic induction and saw that it behaved as I described. The fact is, that with the transmitters now in use you cannot produce electro-magnetic effects in the secondary wire, but just the exact impedance which is necessary to do so with a given receiver, I do not know. I have not had any occasion to determine that and have never done it.

Mr. Kennelly: Then I would beg to mention that in the rough manner I have indicated the ratio of the electrostatic disturbance to the electro-magnetic disturbance as the ratio of the mutual electrostatic capacity to the mutual electro-magnet capacity of the two disturbing wires, per unit of length of either, multiplied by the product of the impedance of the primary, into the impedance of the secondary, divided by two, on account of two telephones. The result is that when you have a large impedance in either one or the other the ratio gets very large.

Mr. Carty: So that from your statement the results, which I described, are in accordance with theory as you have stated it?

Mr. Kennelly: So far as I know, yes.

The President: It seems to me that the experiments that Mr. Carty has described here are extremely interesting and very conclusive as to the effects that take place in a particular case. As I understand him, when his line is grounded at the farther end, in which case you will have a series of currents going back and forth upon it, currents as strong as the telephone transmitter is capable of producing, we have no induction whatever—no sound, in other words, in the telephone. And, therefore, electro-magnetic induction is so small as to produce no effect that can be heard in the telephone; but when he breaks the ground and leaves the far end of that wire insulated, then operates the transmitter, the wire becomes length plus and minus, rising to a quite high potential, then falling to a low potential. We have at once the effect in both telephones, indicating that the electrostatic disturbance is something considerable. It seems to me a very interesting fact and a very conclusive form of experiment.

Mr. Prescott: It hardly seems to me that the experiment is generally conclusive. It merely proves that with the character of current developed by that particular transmitter, the electro-magnetic effects on parallel circuits are feeble.

It is easy to imagine a long line with only receiving telephone in circuit that might be greatly affected by electro-magnetic disturbances arising from the proximity of direct and alternating dynamo currents, and even ordinary telegraph currents. In fact, in the early days of the telephone, when its use was limited, the latter caused the "frying" noises which were the source of much annoyance.

The President: I intended to be understood as applying my remarks to this particular case. Mr. Carty says that when you get your current strong enough, by using a powerful battery and vibrator of rapid

(Continued on page 100.)

Chicago, Ill.—The Electric Bulletin Company; capital, $50,000.

Chicago, Ill.—The Standard Electric Company; capital, $100,000.

Terrell, Tex.—The Ice, Light and Water Company; capital, $50,000.

Toledo, O.—The Wilkes Electric Supply Company; capital, $10,000.

Bala, Pa.—The Bala and Merion Electric Company; capital, $28,000.

Chicago, Ill.—Mutual District Messenger Company; capital, $100,000.

Jersey City, N. J.—The Mexican Electric Company; capital, $300,000.

Elizabeth, N. J.—Standard Light Company of New Jersey; capital, $20,000.

San Francisco, Cal.—The Central Avenue Railroad Company; capital, $1,000,000.

Milford, Pa.—The Milford Electric Light and Power Company; capital, $10,000.

Jersey City, N. J.—The Electric Novelty Advertising Company; capital, $100,000.

St. Clair, Pa.—St. Clair Electric Light, Heat and Power Company; capital, $20,000.

Americus, Ga.—The Americus Illuminating and Power Company; capital, $100,000.

East St. Louis, Ill.—The St. Louis Automatic Phonograph Company; capital, $50,000.

East Liverpool, O.—East Liverpool Western Electric Company; increase of capital stock from $25,000 to $30,000.

Canon City, Col.—The Canon Traction, Light, Power, Land and Improvement Company; capital, $1,500,000.

Monterey, Cal.—The Monterey Electric Light and Power Company; capital, $250,000. E. Ingram and S. W. Smith are interested.

Birmingham, Ala.—Birmingham Telephone Company; capital, $50,000. Incorporators, P. Fitzsimmons, H. L. Underwood and F. Hardy.

Chicago, Ill.—The Simpson Storage Battery Company, to manufacture, deal in and use electrical supplies, machinery, storage batteries and electrical appliances; capital, $10,000. Incorporators, H. M. Day, H. B. Hallock and C. P. Chapman.

Gas and Electricity in Massachusetts.

The Massachusetts House Committee on manufactures is expected to bring in a divided report on the question of allowing cities and towns to make and sell gas and electricity. It was thought early in the session that a bill to this effect would be passed very readily, but it now appears that there is to be very strenuous opposition. A great deal of influence is being brought to bear against it. The friends of the measure are talking of taking some such course as was pursued on biennials—to call a caucus of all those who have committed themselves in favor of the change, and to follow this up with public meetings. A majority of the members, it is said, are on record as favoring this change, and much interest is manifested in seeing how many of them will now vote as they pledged themselves to do when their election was hanging in the balance. The friends of the measure claim that public opinion is more strongly than ever in favor of the change, which is emphatically denied by its opponents. The report of the committee as to its trip down South is anxiously awaited, for it is expected to be a very illuminating one.

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Kate Field's *Washington* is one of our brightest contemporaries, and the editor is one of the most brilliant of women.

They have a wonderful man in St. Paul, Minn. He has been telling the newspaper men out there "how it feels to be killed by an electric current."

It is said that recent tests of the schiseophone, an electrical instrument designed by a Frenchman, for detecting flaws in castings and forgings, prove that it is unreliable. Railroad men will regret to learn this, as it was thought the instrument would be of great value in testing rails.

The good points of the electric railway are continually cropping out. One electric road running near several cemeteries has established a funeral train service; a road in a Western town runs an express and way freight service; and there are numerous roads operating local express passenger trains.

When Queen Victoria went to Grasse, France, the facilities of the little telegraph office were quadrupled, and now we learn that the Queen sends so many "wires" that the office is in bad shape and private dispatches are much delayed. Perhaps the cipher the Queen uses has more to do with the delays than the number of words.

It has been suggested that electrotype foundries furnish plates of copper and zinc by electro-deposition for whatever uses might present themselves. The claim is made that such a business would be quite profitable.

It is to be hoped that the membership of the Electric Club will continue for a long time to increase at the present rate. Very soon nobody inhabiting New York electrical circles will be able to resist the temptation of becoming a member.

It is rather curious, in view of the strained relations between the Mayor of New York and the electric lighting companies, who, in face of many obstacles, strive to illuminate the city, to note that a short time ago the first stone of the new subways in London was laid by the Lord Mayor in person, and that the event was celebrated by a luncheon at which city authorities and electrical engineers mingled in cheerful harmony and made pleasant speeches couched in terms of mutual esteem. Let us hope that the day may come when similar friendly relations shall exist between those who rule the fortunes of New York city and those who seek to supply her with light. Just at present, however, it looks as if that day were far off in the dim distant future.

The founder of American Democracy, Thomas Jefferson, gave utterance to these words:

"Experience has taught me that manufactures are as necessary to our independence as to our comfort."

This was never more true than it is to-day. And what would now be the condition of American manufacturing industries were it not for the inventors? An English scientific journal has asserted that "Americans are the best mechanics in the world."

It is equally true that Americans are the most prolific inventors in the world. The patent centennial celebration, being held in Washington, this week, promises to be a fitting testimonial to American inventors and manufacturers.

THE WAR ON THE WIRES.

The condition of electrical affairs in New York city is little short of a disgrace to a civilized community. The delivery of the control of a scientific industry into the hands of a set of professional politicians, ignorant of everything save the organization of "halls" and parties to run public affairs for private profit, is a scandalous absurdity which verges on the domain of burlesque or comic opera. At present, the electrical companies doing business in New York city are at the mercy of the whims and caprices of the erratic and ill-tempered head of the city government.

The Board of Electrical Control has long since ceased to be anything but a name, and "our energetic young Mayor" runs the whole business to suit his own taste. His taste in matters electr cal is notoriously perverted and uncultivated, and his autocratic rulings at the meetings of the *effete* and dismembered "Board" are chiefly influenced by the condition of his never very equable temper at the time.

The present war of extermination on the poles and wires is ill-timed and unnecessary, and will only have the effect of still further embittering the already sufficiently antagonistic relations between the city authorities and the companies. Some incidents of the pole cutting operations throw a ludicrous light on the motives behind the prompt action of those most interested in the issuance of the order to take down the wires. It appears that in some cases the contractor, who is a brother of one of the commissioners of the Board of Electrical Control, has been much chagrined at finding that the companies' linemen have been beforehand in taking down the most valuable wire, consequently depriving him of the cream of the booty on which he had counted. Some fears exist that the wire cutters may make a few other mistakes similar to that which occurred on the first day, when they cut down live circuits, and interfere with wires which are protected by injunctions. If this were to occur, and we devoutly hope it may, the city authorities would find themselves liable to the pains and penalties which are visited upon those who commit that most awful offence known as contempt of court.

DEPTFORD.

We have on one or two occasions referred to the progress of the mammoth central station at Deptford, which was designed by Mr. Ferranti to supply certain districts of London with current for incandescent lighting, the current being sent from Deptford to London at a pressure of 10,000 volts. Those who favor the high tension alternating current system of distribution will be glad to note that the Deptford station is at last fairly at work and at the present time is supplying current to upwards of 10,000 lamps in London.

Mr. Ferranti's ambitious plans have been looked on with some disfavor in England, notably by our London namesake, which has showered journalistic cold water on the Deptford scheme in abundant quantities and at frequent intervals, but at the present writing it looks as if the prognostications of the engineer have greater chances of fulfillment than those of the learned editors. We in this country have a ready sympathy for the projectors of engineering works of large magnitude, and American electrical engineers have all along taken keen interest in Mr. Ferranti's work. Now, that the work has entered successfully into an era of practical results, we cannot refrain from congratulating the enterprising designer of such a remarkably extensive plant.

LITERARY.

The Bradstreet Company has issued a pamphlet entitled "1890; A Record, Not a Prospectus," containing many valuable statistics of the business world.

"Appleton's School Physics," published by the American Book Company, New York, is by far the best elementary text-book on the subject that we have seen. It has 550 pages of well written and newly illustrated text and is tastefully bound. This volume of "Appleton's Science Text-Books" is intended to meet an existing demand for a thoroughly modern text-book on natural philosophy which shall reflect the most advanced and practical laboratory and pedagogical methods and at the same time be adapted, in style and matter, for use in the higher grades of grammar schools, high schools and academies. In the belief that special investigators and teachers are distinctively qualified for the purpose, the editor, Prof. John D. Quackenbos, has assigned the different sections of the book to educators of recognized eminence and skill, governing his selection in each case by the peculiar qualifications of the author. The reputation of the several contributors, and the standing of the great scientific schools which they represent, must secure for this work a consideration accorded to few American school texts. The sections on motion, energy, force, the properties and constitution of matter, solids, liquids, gases and mechanics proper, were prepared by Professor Silas W. Holman, of the Massachusetts Institute of Technology; those on heat, light, frictional and voltaic electricity, by Francis E. Nipher, Professor of Physics in Washington University, St. Louis. Professor Alfred M. Mayer, of the Stevens Institute of Technology, Hoboken, N. J., furnished the chapter on sound and Francis B. Crocker, E. M., instructor in electrical engineering, School of Mines, Columbia College, the sections relating to magnetism and the practical applications of electricity.

To those about to begin the study of electricity this book offers an opportunity of a preliminary course in physics which cannot prove otherwise than of great value.

To Mr. G. W. Stockley, the retiring president and general manager of the Brush Electric Company, Cleveland, much of the success of that corporation is due. Mr. Stockley became identified with the electrical business in 1878, and was one of the first to join Mr. Charles F. Brush in his early efforts to improve upon the old Gramme dynamo. Mr. Stockley has been connected with the Brush Company in various important positions through all its business career and now, having retired from active business life, he is living quietly at Lakewood, N. J.

CORRESPONDENCE.

OUR CHICAGO LETTER.

Chicago Electric Club.—The annual election of officers of the Club takes place Monday evening, April 16.

The Electrical Supply Company's staff has been obliged to work nights lately filling orders for electric railway supplies.

Mr. P. C. Ackerman, of the American Electrical Works, passed through Chicago this week on his way to California.

Mr. W. R. Mason, of the Electric Merchandise Company, says the past week has been one of the busiest we have had since starting.

Mr. Albert M. Walter who has been with the Great Western Electric Supply Company since starting, has accepted a position with the Illinois Electric Material Company.

Mr. Paul W. Bossart has severed his connection with the Detroit Electrical Works and has accepted a position with the Short Electric Railway Company, of Cleveland.

The Great Western Electric Supply Company report that the demand for the Great Western incandescent lamp has been so large as to make it necessary to increase the factory facilities.

The Central Electric Company have just booked several large orders for their new porcelain break and high resistance insulators from some large electric street railway companies.

Mr K. Wheeler, formerly connected with the railway department of the Thomson-Houston Company, has resigned and will hereafter represent the interest of Mr. Geo. Cutter as general salesman.

Mr. S. S. Leonard was in the city a few days this week. His many friends in Chicago were glad indeed to renew acquaintance. Mr. Leonard was, until a few months ago, manager of the Chicago office of the Hill Clutch Works, of Cleveland, but is now spending most of his time in the home office of his company.

The Rockford Electric Manufacturing Company, represented in Chicago by Mr. F. E. Calkins, have recently made some very desirable installations of the well known Mayo system of generators, dynamos, etc. These machines are all made under the personal supervision of Mr. Geo. A. Mayo, the electrician of the company.

Mr. Wm. Hood has just received a consignment of the Walker recording meters, one of which has been connected up and is working splendidly. The process of photographing the record of current used by this machine is very interesting. It can be seen in Mr. Hood's office at any time, registering from one to 40 lamps burning.

A Working Model of the endless and threadless shaft railway has been placed in position in the offices of the Patton Motor and Manufacturing Company, No. 45 Lakeside building. It is well worth spending a few moments in seeing this work. The system is being introduced by the Judson Pneumatic Railway Company, of New York.

The Franklin Electric Company, manufacturers of electric specialties, have about completed a novel machine which is worked on the principle of a nickel-in-the-slot machine. By dropping a quarter in the slot and stepping in front of the machine your photo is taken, an electric flash develops it, and it is finished, placed in a small frame and the picture delivered to you. This apparatus is working satisfactorily and will shortly be placed on the market.

A Feature of the opening of the new store of the Illinois Electric Material Company was the very tastily dressed windows. Trade marks and names of the many specialties handled by this firm were portrayed by the graceful bending of wires spelling out in full, in some cases, the names of the different articles. The decorations upon the inside were, of course, of a decidedly different nature, but were quite attractive. The firm is now settled in the new building.

Mr. Bain, of the Bain Electric Company, is to be congratulated upon securing so desirable a location for his factory. The floors are large, with perfect light and ventilation, and as the heavy machinery is on the ground floor and all shipping can be done from the same floor, we consider it one of the greatest conveniences that a manufacturer of heavy work can have. The firm are rushed at all times, their repair department being very often unavoidably behind with work.

Mr. W. R. Mason, general manager of the Electric Merchandise Company, was, by a unanimous vote of the directors of the company, elected president of the Burton Electric Heater Company, of Richmond, Va. Mr. Mason has accepted the position and will use every effort to push the interest of this valuable device to the front. It is highly spoken of by all who have them in use, a few of which are the Terre Haute, Ind., Electric Railway, East St. Louis Electric Railway, Piqua, Ohio, Electric Railway and the Lynn & Boston, Mass., Electric Railway.

Among Recent Sales made by the Chicago office of the Mather Electric Company are the following: A 650 light plant to the steamship "Virginia"; also, 250 light plant to the steamship "Atlanta," both of the Goodenrich Transportation Company's line, to be completed June 1, 1891. Additional, 250 light dynamo and wiring for 300 incandescent lamps to the Upham Company, of Marshfield, Wis., for central station work. Additional, 500 light dynamo in the new St. Paul Apartment House, St. Paul, Minn.; 150 light machine to the Centralia, Wis., Pulp Mill and a 250 light dynamo and plant complete to Davidson & Sons, Market street, Chicago. L. W. C.

Chicago, April 4.

OUR ALBANY LETTER.

Senator Vedder has just introduced a bill relating to the electric lighting of villages.

Assemblyman Blumenthal has introduced a bill creating a board of telephone commissioners in cities of over 600,000 inhabitants, consisting of the mayor, comptroller and president of the board of aldermen in said cities. The board shall, within three months after the passage of this act, institute an inquiry into the cost of telephone service and fix the rate that shall be charged.

The Work of Reconstructing the Glens Falls Street Railway on the electric motor basis will be begun on Wednesday or Thursday of next week. Two hundred laborers will receive employment for some weeks. Ten tons of copper wire will be required, about 600 tons of rails, the same number of trolley poles, and about 18,000 ties. The electric equipment for the road, including eight car equipments of two 20 horse-power motors each, will be furnished by the Westinghouse Company.

The Assembly Committee on gas, water and electricity gave a further hearing Wednesday on Mr. Stein's bill creating a board of telegraph commissioners. Superintendent C. D. Hammond, of the Delaware and Hudson Railroad, appeared in opposition to the bill. The committee will report the bill for the consideration of the House, amended by providing that a license may be revoked if the holder is an habitual user of intoxicating liquors. The committee will also report Mr. Southworth's electrical subway bill. This is amended by providing that the New York Board of Electrical Control, with the consent of the Consolidated Telegraph and Electrical Subway Company, may enter into new contracts with the company and the Empire City Subway Company, providing for a division of the work, so that the constructing, maintaining and operating of subways for telegraph and telephone conductors, and for low tension conductors, shall be done by the Empire City Subway Company, all other subways by the Consolidated Telegraph and Electrical Subway Company.

For the Third Time Albany's electrical interests have been paralyzed by a storm. Thursday night and Friday morning a wet soggy snow loaded down the telephone and telegraph wires causing them to snap, and huge poles to break and fall into the streets. For several hours during Friday morning not a motor car moved; but very few telegraph messages were sent out of the city, and not a single telephone was in use. From a wire standpoint the storm was the worst of the season and the most disastrous occurring here in years. During the storm overhead wires caught and accumulated masses of snow until they looked like great strings of popcorn. Nearly 11 inches of wet soggy snow fell. Telephone wires continued to fall in all parts of the city during the day. They crossed the newly strung wires of the fire alarm system and destroyed the efficiency of the service. The tangle was general. Some wires came in contact with the high current trolley wires of the motor roads. During the temporary absence of every one from the chief's office, a fire was set to the window casing by the messenger call box in the fire department rooms, and a lucky discovery of it prevented serious damage. By 10 o'clock the fire alarm service was entirely inoperative. Fire Chief Higgins ordered the electric railways to shut off their power. General Manager Uline was called to the telephone exchange before 5 o'clock. Even then wires were breaking and fires were constantly occurring about the new switchboard, which had just been gotten in good running order, and for which the bill had come that very morning. From 5 to 8 o'clock fires occurred constantly and connections were cut out as rapidly as possible. An examination of the switchboard, after the electrical railway currents had been shut off, showed 200 of the 1,400 magnets were burned out. Mr. Uline at once telegraphed to New York for new ones and men to put them in, and also to send up as many linemen as could be obtained He received requests for linemen from points north of here, but could spare none. The damage to the exchange is trifling compared with that of March 9, but the destruction of lines of wires, both in the city and outside, is greater than even that of the storm of February 7. The accumulation of snow on the wires was so great after 8 o'clock that whole lines fell to the earth. At Pearl and Hamilton streets the telephone wires lay upon the electric light wires. East of Pearl and to Broadway, Hamilton street presented a scene of wreck. At Rose street and again near Green street, large poles, carrying over 100 telephone wires, broke and fell. Supports which had held wires firm on housetops dangled in the air on taut wires; others fell to the ground. The big line of poles along Broadway, carrying 120 wires besides the cables, went down in many places. The three lines in the lumber district of 150, 70 and 30 wires are prostrate. The "big mast" on Starbuck Island, which held all the wires north from this vicinity, also crashed to the ground. A wire crossing North Pearl street broke its fastenings and came in contact with one of the brick pillars on the parapet of the Kenmore Hotel. It was demolished and the bricks fell to the sidewalk. L. M. W.

Albany, April 4.

OUR BOSTON LETTER.

Mr. James R. Magee, manager of the Thomson-Houston Electric Company's isolated lighting department, was on Wednesday presented by his office associates with a magnificent clock. Another evidence of Mr. Magee's popularity.

Mr. W. A. Stiles, one of the most popular and genial officers of the Thomson-Houston Electric Company, has organized a company to construct and operate an electric railway in Weymouth and Hingham, Mass., respectively. A liberal franchise has already been obtained from the selectmen of the towns named.

Interesting.—The *Journal of Finance* remarks that Boston's prospects of becoming the electric headquarters of the country are steadily growing. It will not be surprising, it adds, if the financial offices of the Westinghouse system be established here in Boston at an early date, with Charles Francis Adams largely interested.

The Connecticut Motor Company is reported as having decided to remain in Plantsville, Conn., until next Autumn. This company has, until recently, been making preparations to remove its factory and offices to New Britain, Conn. At the directors' meeting, recently, Mr. R. E. Dunston was re-elected president and Mr. Sherman Blakeslee chosen treasurer of the company. W. I. B.

Boston, April 4.

An Editor's Suspicions Proven.

"In the telephone an alteration of timbre, consisting of a disagreeable stuffing which distorts words, is said to be due to the fundamental note and harmonics of the diaphragm being superimposed upon those of the voice, without becoming confounded with them, and producing a disturbance of the electric waves, of the movements of the diaphragm molecules, and, therefore, of the sound waves which reach the ear."—*Boston Globe.*

We have been convinced for some time that such was the case, but through modesty have refrained from making it public.—*Saccarappa, Me., Chronicle.*

Boston Electric Club.

The Regular Quarterly Meeting of the Club was held at the Club Rooms, 7 Park street, Monday evening, April 6. With reference to this meeting, the following vote was passed at the special meeting of the Club, held the evening of the 30th inst., viz:

"That the secretary be instructed to incorporate in the notice of the regular quarterly meeting of the Club, to be held the evening of April 6, that provided no satisfactory recommendation for the continuance of the Club be reported by the committee appointed to investigate its condition, the question of the continuance or dissolution of the Club will be presented to the members for their action."

FINANCIAL.

Closing quotations of electric stocks, from F. Z. Maguire & Co., Electrical Securities, 18 Wall street, N. Y., Saturday, April 4, 1891. New York, Boston and Washington Stock Exchanges.

NEW YORK.	
Western Union Telegraph Co.	80¾
American Telegraph & Cable	88
Central and South American	*145
Mexican	210
Commercial Cable Co.	104½
Postal Telegraph Cable	39
Edison General Electric Co.	100
Consolidated Electric Light	
Edison Electric Illuminating Co.	70
United States Electric Light	
North American Phonograph	
BOSTON.	
Thomson-Houston Electric Co.	44¾
" " " Preferred	25
" " " Series C	9¾
" " " Series D	7
" " International Co.	
" Welding Co.	
" European Welding Co.	
Ft. Wayne Electric Co	123¾
Westinghouse Electric Mfg. Co	119¾
TELEPHONE:	
American Bell	197
Erie	49¾
New England	50
Mexican	.90
Tropical American	.80
MISCELLANEOUS:	
Edison Phonograph Doll	
WASHINGTON.	
Pennsylvania Telephone	25
Chesapeake and Potomac	58½
American Graphophone	6
United States Electric Light (Wash'ton)	167
Eckington and Soldiers' Home Electric Railway	56½
Georgetown and Tennallytown	60

*Ex. Dividend.

Electric Lighting of Railway Trains.

E. SARTIAUX AND L. WEISSENBRUCK, PARIS.

The technical question involves a description of the various methods that have been tried under the following heads:

1. Primary batteries.
2. Secondary batteries or accumulators.
3. Accumulators charged by a dynamo driven by one of the carriage axles.
4. Accumulators charged by a dynamo driven by a steam engine on the locomotive.
5. The electric lighting of trains passing through tunnels, by means of fixed generating plant, the train making contact with a rail laid in the tunnel.

Taking these in order, the first system has been tried in England, America and on the Continent, but may be said to be now definitely abandoned.

Lighting by means of accumulators is now adopted in almost every instance, in one or other of the methods above, viz., 2, 3 or 4.

Prolonged experiments on the Pennsylvania Railroad, and also on the Boston and Albany Railroad, have shown that under working conditions, an efficiency of 60 per cent. and an output of four and a half ampere hours per pound of electrode, or three ampere hours per pound weight total, may be obtained from cells of the E. P. S. form (lead grids pasted with lead oxides).

Experience has also shown that it is preferable to use low volt lamps—not exceeding 30 volts—and to use a lamp of six or eight candle nominal, with reflectors.

Experience on the railways quoted above showed that an annual depreciation of five to 10 per cent. for the negative plates, and of 30 per cent. for the positive plates, would represent a fair average. The average allowance now made in America for a depreciation fund is 25 per cent. on the original total cost of the cells. The lamps last from 800 to 1,200 hours; but more generally about the former, the vibration being the chief cause of breakage of the filaments.

On the state railways in Belgium the system tried is the same as that used in England on the London, Brighton and South Coast Railway, consisting in the use of a dynamo driven from the axle of the guard's van, in which also is placed the battery of accumulators, the connection from the dynamo to the accumulators being broken when the speed of the train falls below a certain limit.

An extension of this principle was adopted by the Southern Railway in Austria, where a centrifugal governor varied the number of accumulators, in correspondence with the velocity of the train, so as to produce a constant electro-motive force at the terminals of the dynamo feeding the lamps.

In another system tried by the management of the Frankfort-on-Main line, the accumulators were in series with the lamps (the latter, however, being in parallel with one another) as long as the train was running, the cells being two parallels.

When the train stops and the accumulator alone feeds the lamps, the two parallels are coupled in series, and disconnected from the dynamo. The system is very complicated in its details.

In some trials on the state railway of Wurtemburg, a different arrangement was made. Each carriage has its own accumulators, and these with the lamps were fed from one pair of mains, connected to a dynamo in the guard's van. An automatic switch inserted or removed a resistance from the lamp circuit of each carriage, according as the cells were charging or discharging. The dynamo itself was controlled by an automatic regulator, and the dynamo cut off when the speed became less than about 18½ miles per hour.

The system used on the Midland Railway is the same as the first tried at Wurtemburg, with the addition of a third wire carried along the train, and allowing the guard to extinguish the lights when unnecessary.

The use of a separate engine driving the dynamo on the locomotive has been tried in America, and also in England on the Great Eastern and Great Western Railways. No details are given as to results.

The only two cases at present of lighting trains in tunnels from a central rail fed by a fixed dynamo are the Glasgow City Railway and the tunnels on the line between Kieff and Odessa, while on the Fitchburg (U. S.) Railway the whole tunnel is itself lighted by 16 candle-power lamps.

The only information given as to the cost of lighting trains in tunnels by means of a central rail is that in Russia the cost is one-third that of gas.

The comparative cost of lighting by gas and oil is given as follows: Gas from 0.86 pence to 0.48 pence, and by oil 0.54 pence. As to dead weight carried, the accumulators necessary for a saloon carriage, requiring 21 lamps, weigh 1,200 pounds, and the apparatus for Pintsch gas illumination for the same carriage would weigh from 990 to 1,000 pounds.

Telephonic News

*** A long distance telephone line is to be established between Elmira and Ithaca.

*** It took 2,755 pounds of wire to repair the telephone circuit between Plainfield and Elizabeth, N. J.

*** According to statistics, Three Rivers, Mich., has more telephones in use than any other town of its size in the United States.

*** We need a telephone across the bay. It would save many unnecessary steps and much valuable time.—*Manatee, Fla., Advocate.*

*** The New England Telephone and Telegraph Company has declared a dividend of 75 cents per share, payable May 15, 1891, to stock of record, April 1, 1892. The transfer books close from April 3 to May 4, 1891, inclusive.

*** The New England Telephone and Telegraph Company is building a new wire between Exeter and Newburyport, Mass., and Portsmouth, N. H. The line will be run parallel with the present grounded wire, making a complete metallic circuit. This will give Portsmouth better telephonic communication with Boston.

*** By the terms of the concessions granted to the Bell Telephone Company by the Belgian government, the company may be bought out by the government at any time after ten years from the date of the grant. As this time expires in a little over a year, efforts are being made by the subscribers to persuade the government to exercise its rights.

*** The Erie Telephone directors have accepted the proposition of the Texas syndicate to purchase a portion or all of the stock of the Southwestern Telegraph & Telephone Company, owned by the Erie, subject to certain modifications—which have been accepted by the syndicate—and the ratification by the Erie stockholders. It is said that the $700,000 to be paid will give Erie stockholders $14 per share extra dividends and that the purchase money will probably be paid out in instalments extending over a period, and not in a lump sum.

The Wiring of Buildings.

Mr. W. J. Jenks, of the Edison General Electric Company, of New York, in a recent lecture before the Insurance Library Association, of Boston, stated that the sooner architects, in making their plans and specifications for buildings, allowed for electric wires as they now do for gas and water pipes, the better for the safety of real estate; as to-day most fires emanating from electric wires are traceable to poor construction and lack of allowances in building to wire properly. Most buildings to-day that are lighted by electricity were never built with that intention, and an electric illuminating company, in putting in an installation, has to run wires as best it can by boring holes here and there, damaging the building to an extent and running wires in places that are unhandy and sometimes unsafe. If, in the original plans of the building, electric wires were allowed for, Mr. Jenks thinks there would be no cause for short circuiting or grounds, as there is now, and the installation properly done would be far safer than gas. It seems strange that architects in general should ignore these facts which have been expounded time and time again. To-day, the majority of the large buildings in our cities are run with electric wires of some sort, and those that are not, it is safe to predict, will soon be, as the electric current is becoming more of a necessity in our civilization. The Boston Board of Fire Underwriters has realized the necessity of wiring buildings properly, and gives lower rates to buildings properly wired for electric lighting than to those illuminated by other means.

The London-Paris Telephone.

The telephone cable across the Straits of Dover has now been laid and conversation may be carried on. The connecting cable, which is the joint property of the two governments, was designed, says *Engineering*, by Mr. W. H. Preece, electrician-in-chief of the post office, and contains four separate conductors, two for each circuit. Each conductor is a strand of seven very pure copper wires, weighing 160 pounds per nautical mile or knot, with a resistance of 7.478 to 7.632 ohms per knot at the testing temperature of 75 degrees Fahrenheit. It is covered with three alternate layers of Chatterton's compound and gutta-percha, weighing 300 pounds per knot. The total weight of each core is, therefore, 460 pounds to the knot. The insulating resistance from the wire to the water is not less than 500 megohms per knot after lying in water at a temperature of 75 degrees Fahrenheit for 24 hours before the test, and after the conductor had been electrified for a minute. The capacity for induction between the wire and the water outside, which is so harmful in blurring the delicate ripples of the telephonic currents and thickening the speech, does not exceed 0.3045 microfarads per knot. The cores are twisted spirally round each other in a strand, so as change places like the land wires; and to silence the cross talk as much as possible, the opposite wires form part of the same circuit. The stranded cores are served with tanned hemp, and on this cushion is laid a spiral sheathing of 16 galvanized iron wires, each 0.28 inch thick, with a breaking stress of 3,500 pounds. Clark's coating of mineral pitch and sand protects the whole.

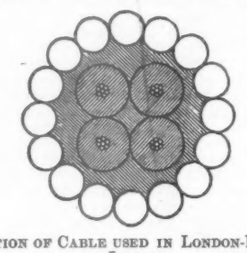
The overland wire from London runs along the South Eastern Railway to a point near Sidcup, and thence by road and rail through Swanley, Maidstone and Ashford, to the cable house on the beach at St. Margaret's Bay, between Dover and Deal. The wire is of copper, the best material for the purpose, and weighs 400 pounds to the mile. It is nearly pure, and has a resistance of about 2.25 ohms a mile at 60 degrees Fahrenheit, the standard temperature for testing. It is supported on creosoted wooden poles, 70 yards apart, by means of double-shed porcelain insulators about 25 feet above the ground. The going and returning wires of each circuit are twisted spirally round each other all the way, so as to exchange their places, and, by cancelling the induction, to prevent the overhearing of messages on other lines. The twist is made by attaching the wires to the insulators in a rotation, and the spiral is completed by each wire regaining its normal position at every 280 yards. The connection between the last pole on the chalk cliff at St. Margaret's Bay and the cable-hut on the beach is effected by lengths of the cable core inclosed in an iron pipe and buried in a trench down the face of the cliff. The whole line is 85 miles long, and its excellence is proved not only by the electrical tests, but by the wonderfully clear and loud speaking through it between Paris and the General Post Office. The French land line follows the direct route of the Chemin de Fer du Nord, through Montdidier and Calais to the cable-house at Sangatte, between Calais and Boulogne. It is similar in construction to the English line, except that only one circuit is run at present, and the copper wire weighs about 600 pounds a mile. Its length is about 204 miles, and the speaking, with the D'Arsonval apparatus employed in France, is also excellent.

The K. R. or product of the inductive capacity and copper resistance of the entire line from London to Paris is estimated at 5,300. The cable was manufactured by Messrs. Siemens Brothers, of Charlton.

The proposal to connect Paris and London by telephone came originally from the French administration. The scheme involved the construction of a trunk telephone line between the two cities, with a novel feature in the shape of a telephone cable across the Straits of Dover, the first ever made for the open sea. It was decided to have two separate circuits, so that if one should fail at any time the other might be in use. The route for the English land line was chosen by Mr. Edward Graves, the engineer-in-chief of the post office, who has taken a keen personal interest in the whole work. It runs along the South Eastern Railway to a point near Sidcup and thence by road and rail through Swanley, Maidstone and Ashford to the cable house on the beach at St. Margaret's Bay, between Dover and Deal.

The building, which began in September last, was continued throughout the severe frost, except when it snowed too hard to see, and the work was completed by the first week in March.

On the morning of Monday, March 9, the French end was landed. It was half-past nine when the lifeboats were launched, and 12 minutes to 11 when the end was landed. No time was lost in returning to the ship, which immediately started paying out towards St. Margaret's Bay. As yet there were no signs of an approaching storm; but it was not until towards three o'clock, when 10 miles of cable had been paid out, and the "Monarch" was half way over, that the gale came on and the water became rough. The glass fell rapidly, and soon a blinding snowstorm swept over the vessel. The sea was lashed into fury by the violence of the gale, which increased to nine degrees, but the decks of the "Monarch" rode high, and



SECTION OF CABLE USED IN LONDON-PARIS LINE.

there was little or no spray. At length it was decided to anchor until a lull in the storm should reveal the land, if only for a little while. The cable was fastened and the anchor rattled out soon after four o'clock.

It was not until the 14th that it was possible to land the English end of the cable. The "Monarch" arrived at St. Margaret's Bay about 20 minutes past three in the afternoon, where she anchored 1,000 yards away from the landing place. A raft was speedily formed with the lifeboats, and the shore end landed in the same way as at Sangatte. The end was hauled ashore by sailors at 10 minutes past six, and 12 minutes later brought into the cable-hut. The end of the cable was then stripped and the sheathing filed off. The cores were then pared and the cable connected to a Morse apparatus, by which the hut was put in communication with Sangatte. The French electricians there telegraphed a "hurrah for the telephone," and the work was done.

It was arranged that no telephonic communication should be held between London and Paris until the French engineers arrived in London, and on Tuesday the first words were spoken by M. Amiot. At 4.15 P. M. he addressed his colleagues in Paris, his first words being "Hallo, hallo!" Mr. Graves, Mr. Preece and others afterwards spoke through the line. A formal inauguration took place on Wednesday, when the first message transmitted was one from the Prince of Wales to M. Carnot. An exchange of congratulations then passed between Mr. Raikes and M. Jules Roche. At the Paris Central Telegraph Office, Lord Lytton, Mme. Roche, M. Reinach, M. Broquisse and M. de Selves were present with M. Roche. Mr. Raikes spoke from his room at the Post Office. Finally, in the afternoon, the members of the Press conversed with Paris. In the accompanying engraving we illustrate a section of the cable.

Electrocution News.

Nicola Trezza, who is in Sing Sing under sentence of electrocution, has signed an affidavit to be used in a motion for a new trial, on the ground of newly discovered evidence. The application for a new trial is to be made in a day or two, by his lawyer, ex-Judge A. H. Dailey, of Brooklyn, who received Trezza's affidavit.

Charles McElvaine, condemned to death for the murder of grocer Luca, in Brooklyn, still hopes to escape the capital penalty. His friends are preparing a petition for the commutation of his sentence, and among other signatures they have secured that of T. F. Connolly, one of the jurors who convicted him.

American Bell Telephone Company's Annual Meeting.

Mr. John E. Hudson presided at the annual meeting of the stockholders of this company, held in Boston, March 31, 1891. Charles Eustis Hubbard was re-elected clerk; William R. Driver was unanimously elected treasurer.

Mr. Hudson, the president, then read the annual report, which stated the increase in the number of stations during the year as 17,928. The estimated number of exchange connections daily in the United States is 1,438,294. The average cost to the subscriber varies, according to the size of the exchange and character of the service, from less than 2 to 14 cents per connection.

There was an increase of 28,147 underground wires during 1890, and an increase of 38,929 instruments under rental.

The miles of wire at the first of January, 1891, 240,412, against 193,213 on the first of January, 1890, shows an increase in that direction of 47,199 miles. Of this, something over one-half, 27,573, is a gain in mileage of wire underground—a gain that exceeds the total mileage of underground wire existing at the beginning of the year. This marks the rapid development and occupation of the underground systems, largely in New York, Chicago and Boston.

The New England Company's new switchboard has been set up. The switchboard will be in operation about the first of May, and the direct connections from the new office to subscribers' stations, through the extensive underground system of conduits and cables radiating from the Telephone Building, will be completed within three or four months thereafter. With its enlarged capacity and improved equipments, the exchange will thus be in a condition to meet the requirements of its rapidly growing business.

The report was accepted and placed on file.

The treasurer's report was as follows:

DEBTORS.

Telephones	$919,274.94
Real estate	744,333.00
Stocks	32,740,580.03
Merchandise and machinery	9,932.94
Bills and accounts receivable	2,034,280.02
Cash and deposits	187,935.39
Total	$36,636,336.32

CREDITORS.

Capital stock	$12,500,000.00
Debenture bonds, 1888	2,000,000 00
Bills and accounts payable*	1,334,636.14
Patent account (profit and loss)	10,516,544.96
Profit and loss	5,645,131.11
Reserve	2,489,012.50
Surplus	2,151,011.61
Total	$36,636,336.32

* Of this amount $375,000 is the dividend payable January 15, 1891, to stockholders of record December 31, 1890.

EARNINGS.

	1889.	1890.
Rental of telephones	$2,657,361.90	$2,913,368.63
Dividends	1,230,500.53	1,226,274.19
Extra territorial and branch lines	82,556.62	89,478.13
Telegraph commission	22,367.02	26,491.60
Interest	43,964.44	77,447.89
Miscellaneous	7,954.19	12,230.44
	$4,044,704.71	$4,375,290.88

EXPENSES.

Expenses of operation	$269,493.37	$311,437.96
Legal expenses	144,566.62	123,359.08
Interest and taxes	225,199.97	257,174.85
Commission	511,215.31	575,221.08
Royalty	10,500.00	10,000.00
Concessions	221,288.11	228,573.94
Miscellaneous	3,702.64	105.65
	$1,385,966.02	$1,505,872.58
Net earnings	$2,658,738.69	$2,869,418.35
Miscellaneous items to surplus account	3,150.00	
Totals	$2,661,888.69	$2,869,418.35
Surplus account, Dec 31, 1889	$2,151,011.61	
Net earnings, 1890	2,869,418.35	
		$5,020,429.96
Regular dividends in 1890	$1,463,913.00	
Extra dividends in 1890	750,000.00	
Reserve for general depreciation	600,000.00	
Reserve for depreciation of instruments	55,505.35	
		2,869,418.35
Surplus account, Dec. 31, 1890		$2,151 011.61

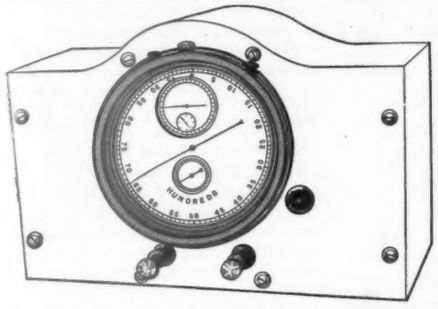
The election of a board of directors for the ensuing year then took place, and resulted as follows: Thomas B. Bailey, Francis Blake, Charles P. Bowditch, George L. Bradley, Alexander Cochrane, William H. Forbes, Henry S. Howe, Charles Eustis Hubbard, Gardiner G. Hubbard, John E. Hudson, Charles E. Perkins, Thomas Sanders. The board of last year was re-elected, with the exception of the substitution of the name of Thomas B. Bailey for that of Stanton Blake, who is ill. The meeting then adjourned.

Electrical Counter and Shaft Revolution and Direction Indicator.

BY W. D. WEAVER, ASSISTANT ENGINEER, U. S. NAVY.

During the frequent trials of steam launches and other fast-moving machinery at the New York Navy Yard, continual trouble was experienced with mechanical counters, and the electrical counter, an illustration of which accompanies this, was devised to replace the former.

It consists essentially of an electrical escapement in combination with a stop-time-piece. By turning the lever on the left, the time movement is started and stopped at exactly the same instant as the escapement, and thus we have simultaneously the time and number of revolutions. The other two



projections shown are to bring the hands of the watch and counter, respectively, to zero.

The counter has proved very useful in many ways, particularly in getting the slip of launch screws over a measured course. It could be arranged aboard ship to take in succession the revolutions of the main and auxiliary engines by leading a wire from each to a switch at the instrument, which could be placed in the most convenient place. At the highest speed tried on a lathe, 1,500 revolutions per minute, the counter proved to be accurate, not losing a revolution in over 10,000, as measured by a mechanical hand-counter attached before the lathe started and read after it had been stopped. It is probable that one can be made to work to several thousands of revolutions per minute; the present one was made from parts taken from a scrap-heap, and its success is largely due to the mechanical skill of Mr. J. S. Gordon, of the New York Navy Yard.

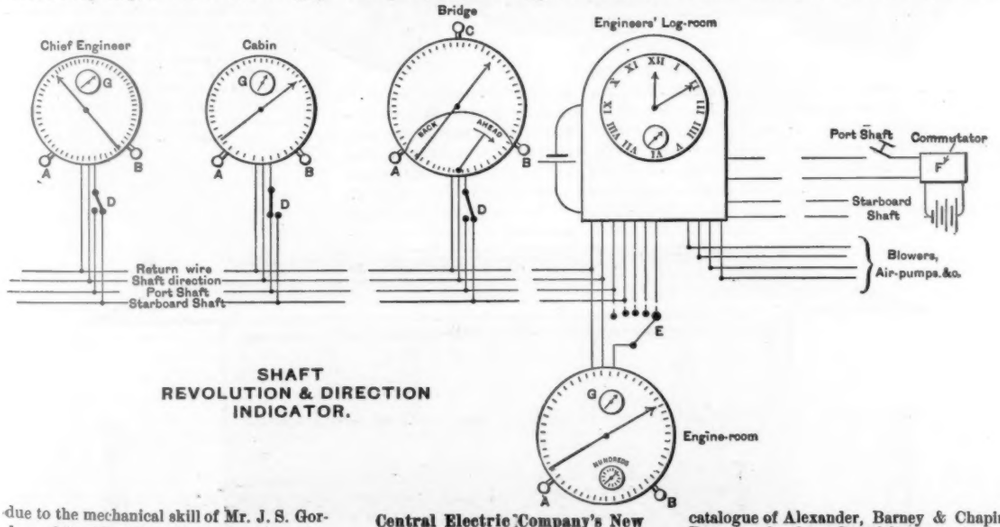
The success of the counter demonstrated the feasibility of a revolution indicator which the writer has long had in view, and which has since been designed in all of its details but not yet constructed. The accompanying diagram shows the arrangement and general appearance of the revolution and direction indicator, and the essential principles are given in the following description:

On each shaft of the main engines, and on as many auxiliary engines as desired, one or more contacts are made at each revolution, each of which sends a current to any register that is open to the circuit. On the shafts of the main engines is a simple form of commutator, *F*, by means of which the direction of motion of the shaft is also shown on the register. All of the shaft circuits are led to a clock, in connection with which is a device for changing from one series of circuits to a second one, and *vice versa*, at regular intervals of time. From the clock, circuits are led to as many registers as are desired, the number that can be put up being practically unlimited; four are here shown, one of which, that in the engine-room, having also circuits from the auxiliary machinery.

The method of working is as follows: When a reading is desired, it is first observed if the direction hand, marked *G*, is indicating; if it is, it will be necessary to wait an interval of time, the maximum of which is ten seconds, until it returns to the zero mark. When it is at the zero mark the button *A* is pushed in, and after another interval, the maximum of which is ten seconds, the revolution-hand begins to move and stops at the figure corresponding to the number of revolutions being made per minute, and remains there until *B* is pushed in, when it returns to zero ready for another indication. It is thus seen that before a reading can be taken, an interval of time between 30 and 10 seconds is required; it is not necessary, however, to stand by the register, as, after the button *A* is pushed in, the hand will remain at the point at which it stops until returned to zero by *B*.

On the register for the bridge the direction-hand is made large and a lever *C* added, by means of which it may alone be kept in the circuit and indicate continuously as long as desired. To the engine-room register are connected in addition, by means of a switch, circuits from the various auxiliary engines, so that their revolutions may be taken singly or in succession when desired.

The ideal revolution indicator is, of course, one that will show at a glance at any time the number of revolutions the engine is making, but of all of these that the writer knows of or has imagined, none seems to be practicable or sufficiently accurate. On the other hand, the apparatus here described is positive in action and accurate, and, from the simplicity of its parts, little liable to get out of order.



SHAFT REVOLUTION & DIRECTION INDICATOR.

Central Electric Company's New Catalogue.

The Central Electric Company, Chicago have sent out a third edition of their new catalogue. It is a book of 300 pages, about 8x10 inches in size and well bound in a stiff cover. A most comprehensive line of electrical displays is illustrated and priced. A convenient "trade word" telegraph code is included and is designed to facilitate ordering by wire. Insurance rules, valuable tables and handy data, make a large appendix. The book forms a progressive catalogue of progressive wares sold by a progressive firm in a progressive city.

The South Side Electric Company, of Scranton, Pa., has sold its franchise to New York capitalists.

Electric Lighting in Rochester, N. Y.

The following is a portion of the report of the Lamp Committee, of Rochester, N. Y.:

Statement relating to the public lights of the city:

Kind of Public Street Lamp in Use.	Total Number of Lights April 1, 1890.	Number of Lights added During the Year.	Number of Lights Discontinued During the Year.	Total Number of Lights, April 1, 1891.	Price per Light, per Night, each, Cents.
Brush Electric Arc.	982	31	..	813	28
Rochester Electric Arc.	267	12	..	279	25½
Edison Electric Arc.	43	8	..	51	25½
Edison Electric Incandescent	790	22	25	787	5¾
Rochester Gas	115	29	2	142	5
Municipal Gas	215	..	2	213	5
Citizens' Gas	509	3	55	457	5

Total number of lights added, 105.
Total number of lights discontinued, 84.
Total number of public street lamps in use, 2,742.
The various public lights are classified as follows, viz:

Electric Arc Lights	1,143
Electric Incandescent Lights	787
Gas Lights	812

PERSONAL.

Professor Elisha Gray was in New York, last week, registering at the Windsor Hotel.

Mr. F. W. McClement has been appointed acting general manager of the Universal Arc Lamp Company, 49 West Twenty-second street, this city, *vice* Mr. E. S. Mendels, who has resigned his position as general manager.

The "A. B. C." Catalogue.

The arrangement of industrial catalogues has received much study within the past few years, and during that time many of the electrical concerns in the country have issued little works of art to advertise their wares among the trade.

The latest addition to our collection of artistic catalogues has just come to hand. We refer to the book just issued by Alexander, Barney & Chapin, descriptive of the numerous electrical supplies they deal in, and illustrated profusely by well-made cuts of the same. In all, 2,000 articles are mentioned in their catalogue, and it is only by the study of such books as these that we can realize the numerous appliances used in the art. It must have taken weeks of hard work to collect a book so complete as the catalogue of Alexander, Barney & Chapin. But not only the value of its contents, but its outward appearance will make it an article welcome at any office desk.

The cover, which has been designed by Bartlett & Company, of this city, consists of two designs appropriate of the profession. On the front page a beautiful design of the original magneto-electric machine worked by three little imps, who we suppose are to represent the three gentlemen composing the "A. B. C." The back of the cover shows an infant struggling with a winning smile and an "A. B. C." incandescent lamp to make the world brighter and happier.

The whole cover is of heavy white pasteboard, and closes with a switch which seems to be connected with flexible cord encircling the whole book, a unique design of the engravers.

This catalogue will undoubtedly be in demand in electrical and allied circles.

TELEGRAPHIC

.... The offices of the Western Union and the Postal Telegraph Companies, of Newark, N. J., were burned out April 2. Loss estimated at $20,000.

.... The United Telegram Company has secured an exclusive contract for ticker privileges at the Boston Stock Exchange, to begin on or before the exchange moves into the new building. Report has it that this company bid $10,000 for the privilege, and that the Gold and Stock Company declined to compete.

Wesley's Electricity.

While the religious sect which he founded has been celebrating the centenary of John Wesley, how many of his followers have been made aware that he was the author of a work on electricity? This curious *brochure* was published in 1759, under the title of "The Desideratum; or, Electricity made Plain and Useful, by a Lover of Mankind and of Common Sense." The titles of the sections are decidedly suggestive: "Electricity the Soul of the Universe;" "The Cat in the Oven, Curious Electrical Experiment;" "A Person with Small Pox Cannot be Electrified;" "Electricity the Greatest of all Remedies." The reverend author goes in for a serious argument to demonstrate that it is "just as *innocent* to keep our rooms tight from lightning, as from wind and water." One of the entries is as follows: "Exp. 33. A Person standing on the Ground cannot easily kiss an electrified Person standing on the Rosin." About half the volume is taken up with narratives of cures supposed to have been wrought by electrifying, the diseases being of the most varied kind, from fistula to epilepsy. Even the cure of moral diseases is attributed to electricity. "*Felons* are speedily cured by drawing Sparks. If any disorder be superficial this Operation suffices: But if it lie deeper, then the giving of Shocks is found to be more effectual." The good old divine had probably little idea what mischief his well-meaning recommendations of electricity might work. Happily, in science more weight is attached to proved facts than to the authority of a great name. And Wesley's attempt to intervene in science was less successful than his intervention in ecclesiastical organization.—*London Electrician.*

Improved Key Socket.

We illustrate herewith a new key socket which is just being brought out by the Star Electrix Company, of Philadelphia.

It is an improved form of the well known Electrix socket, which has had such an extensive sale since its introduction. The interior body of the socket is made from one piece of porcelain, which is easily removed

from the shell when it is desired to wire to a fixture. The key movement is exceptionally strong, so that the socket comes a 50 candle-power lamp without injury.

The Electrix Company report a very active demand for all their specialties, including single and double pole switches, key and keyless sockets, gas attachments, cut-outs, etc.

* * Indianapolis, Ind., is clamoring for rapid transit.

* * Denver men have secured a franchise for an electric street railway at Albuquerque, N. M.

* * It is probable that the fare on the electric railway at Helena, Mont., will be increased from five to ten cents.

* * Mayor Chapin, of Brooklyn, spent several days in Boston, last week, examining the overhead trolley system.

* * The aldermen of Cambridge, Mass., have refused to allow the electric cars to run across the Brookline bridge from Brookline to Cambridge.

* * The new electric street railway company of Marquette, Mich., will issue half-fare tickets to all employés of the Hawley saw mills who work outside of the city limits and who reside in the town.

* * The street railroad project is yet in the distance, and not hailing distance, at that. The opportunity for some "Rise-up-William Allen" hustler is immense—immense.—*Corning, N. Y., Journal.*

* * In the Providence, R. I., common council, last week, the committee on railroads reported recommending the granting of the petition of the Union R. R. Company for right to use overhead trolley system on its Broad street route to Pawtuxet.

* * A method of blasting by electricity has been tried in Sweden with reported good results. The means consist of a voltaic arc produced between two carbon rods placed parallel. When the arc is moved close to the spot to be blasted an intense local heat is created, resulting in expansion that splits the rock.

* * The project of constructing a trolley system of electric railway along the route of the Ridge road, from Rochester to Niagara Falls, and a branch running from Lewiston to Youngstown, also a branch from Wright's Corners to Lockport, N. Y., is receiving the attention of capitalists and parties residing on the line of the proposed railroad.

* * That the workingmen are interested in the question of electric roads is evidenced by the fact that several subscriptions have been received from the employés of the shoe and tack factories at Whitman, Mass., for stock in the proposed Hatherly Street Railway Company. At the Rockland factory of Wright & Richards over $2,000 have been pledged.

* * The Thomson Electric Welding Company has contracted with the Pullman Palace Car Company for a large welding plant at Pullman, Ill., for miscellaneous car work. Other recent orders are those for additional welding plants at the Electric Wheel Company, at Quincy, Ill.; Kentucky Wagon Company, at Louisville, and the Johnson Company, Johnstown, Pa.

* * The stockholders and directors of the Olean Street Railroad Company, Olean, N. Y., have decided on progressive improvements for their line. Horse cars will be abandoned and electric cars substituted. New rails will be laid along the entire system, and all improvements will be made. It is probable also that the system will be extended to Alleghany, a distance of three miles.

* * Harry N. Marvin, inventor of the electric percussion drills, last week gave an exhibition for the Edison General Electric Company at the quarry of Churchill & Hitchcock, Quincy, Mass. The drill made a hole 16⅛ inches in 15 minutes, and another, a side hole, in a standing position, 18 inches in eight minutes. Quarry owners and miners from all parts of the country witnessed the exhibition and expressed their satisfaction at the work done.

Westinghouse Ironclad Gearless Railway Motor.

Following upon the production of their single reduction motor, the Westinghouse Electric & Manufacturing Company, Pittsburgh, have brought out an ironclad gearless railway motor which we illustrate herewith. Fig. 1 shows a side view, Fig. 2 a front view and Fig. 3 a car equipped with the motor.

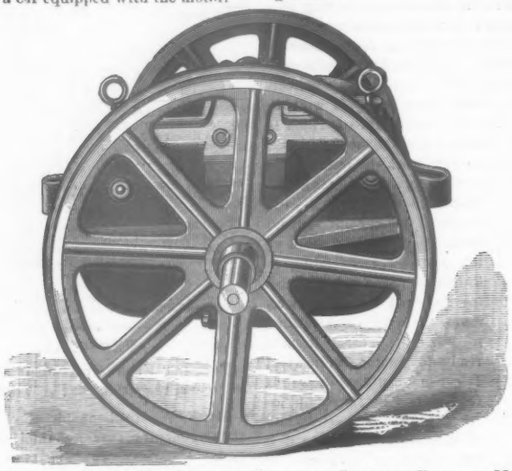


FIG. 1.—SIDE VIEW, WESTINGHOUSE IRONCLAD GEARLESS RAILWAY MOTOR.

The motor is completely surrounded and protected by the field frame, which forms a natural casing of sufficient strength to withstand all shocks and obstructions of the road-bed. The field consists of two symmetrical castings of special iron sleeved upon the armature shaft or axle, hinged on top and secured together by bolts. The joints are made water-tight and the bearings are provided with leather cups for the same purpose, which makes it dust-proof and possible to operate the motor on inundated tracks. The armature, which is of the drum type, is built upon the car axle. The sheet-iron disks, being solid and keyed to the axle, give the axle an additional strength, which precludes any possibility of its bending. This arrangement, of course, eliminates all gearing. The armature is but 16 inches in diameter with a grooved periphery for the wires, which not only increases the efficiency, but holds the wires absolutely rigid. Special attention has been given to the design of a commutator of great solidity and durability. It is securely fastened to the shaft, and connections with the armature are made by short, heavy wires which will overcome the trouble which has been experienced from broken connection. The brush holder, which is rigidly fastened to the magnet frame, is of very simple design, well insulated and easily accessible by openings provided with water-tight lids.

The weight of the magnet-frame is counterbalanced and cushioned upon powerful spiral springs which rest upon the cross bars of the truck. These springs prevent the field from rotating, and give the motor the necessary flexibility for easy starting. The total depth of the ironclad gearless motor is but 20 inches, giving 5 inches clearance between the bottom of the motor and the rail, with a 30 inch wheel. One point of great importance is the ease and rapidity with which these motors can be changed. In case of accident, one end of the car body may be raised by means of jacks, and by simply unscrewing two nuts, the motor can then be rolled out on its wheels and a complete motor, which may be kept tested in the car house for that purpose, can be rolled into its place. The fields of the motor can then be opened, which will at once liberate the armature. For all this no pit is required and the work can be done intelligently and conveniently.

FIG. 2.—FRONT VIEW, WESTINGHOUSE IRONCLAD GEARLESS RAILWAY MOTOR.

The Westinghouse Company claim that their ironclad gearless is the most efficient railway motor now on the market, actual tests having shown a working efficiency of over 90 per cent. It is said that after a two hours' run with a load of over 20 horse-power the rise in the temperature of the armature and field coils was only 30 degrees centigrade above the surrounding air. All sparking is avoided by the excellent electrical design. This form of motor is naturally free from leakage and external magnetism. On account of the absence of gears, it is claimed that at least five horse power per car is saved over the double reduction motors—therefore requiring less generating capacity for a given number of cars. The wear and tear and maintenance on cars equipped with these motors, it is claimed, will be greatly reduced on account of the low speed of the wearing parts, small inertia of the armature and the low peripheral speed of the commutator. The comparatively light weight of the equipment, dispensing with the weight of an elaborate truck, is a point that should be carefully considered. The ironclad gearless can be adapted for any and every gauge, from three feet six inches up.

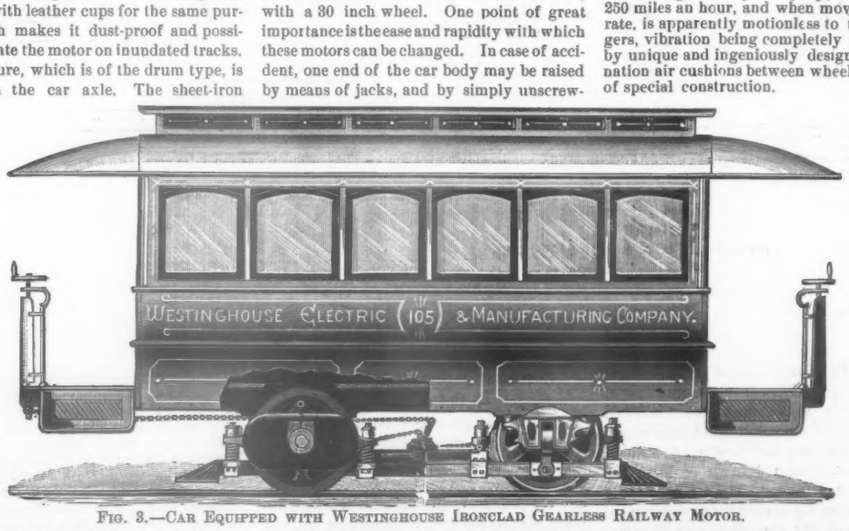


FIG. 3.—CAR EQUIPPED WITH WESTINGHOUSE IRONCLAD GEARLESS RAILWAY MOTOR.

Electric Cars Run for Charity.

The Rapid Transit Electric Railroad Company, of Newark, N. J., gave all of its Easter Sunday receipts to the three Newark hospitals which are sustained by charity—St. Michael's, St. Barnabas' and the German. The traffic was unusually heavy, and many passengers refused change for bills and looked on with satisfaction as the conductors pulled the fare registers 20 or 40 times. Before the cars started from the shed in the morning, the indicators were set at zero, and when the first car was ready to go, President Ellis Ward stepped aboard and rang up $90 worth of fares, representing a brewer's contribution of $50 and a lot of $5 notes sent to the company. It was calculated beforehand that the company would give at leas $700 to the hospitals, but when everything was counted the treasurer had to draw a check for $902.44. The money was sent to Mayor Haynes for distribution.

The Electric Limited in 1900.

The REVIEW hereby acknowledges the receipt of an annual pass on the Kansas City Electric Limited for the year 1900. On the back is printed the following:

NOTICE.—This pass is not transferable, and will be forfeited if presented by any other than the person whose name appears on the opposite side.

This train is composed of aluminum cars and is propelled, heated and lighted by electricity from the improved storage system, manufactured by The Western Electric Storage Battery Company; its speed is 250 miles an hour, and when moving at that rate, is apparently motionless to the passengers, vibration being completely eliminated by unique and ingeniously designed combination air cushions between wheels and rails of special construction.

The weight of this train is greatly reduced by hydrogen gas uniformly distributed throughout each car, and its pointed ends prevent friction in front and suction in the rear.

It is expressly understood and agreed to by the holder of this pass that no claim for damage on account of death, resulting from loss of breath or heart failure, will be recognized unless presented to Thos. F. Clohesey, consulting and contracting electrical engineer, Kansas City, Missouri, U. S. A.

Expires December 31, 1900.

Queen Magnetic Vane Ammeters and Voltmeters.

Queen & Company, Philadelphia, have brought out the improved measuring instruments shown in the accompanying illustrations. The construction of these instruments has been somewhat changed since they were first placed on the market. The peculiarities of the magnetic vane ammeters and voltmeters, which recommend them to electrical engineers, are low prices, absence of permanent magnets, accuracy, strong construction

FIG. 1.

and handsome appearance. Queen & Company do not claim that their magnetic vane instruments are absolutely accurate, but they are quite accurate enough, within one or two per cent., for commercial purposes. As they contain no permanent magnets, the annoying inaccuracies due to change in magnetism, which cannot be overcome where magnets are used, are entirely absent. The instruments contain no delicate parts liable to injury, but are of good, solid construction; in consequence, being well adapted to usage which station instruments necessarily receive. The voltmeters, as well as the ammeters, can be left in circuit, so they may be fastened permanently on the switchboard, if desired.

FIG. 2.

These instruments are designed especially for central stations, isolated plants, marine installations and railway work, and are well adapted for general experimental work.

For central stations, the large ammeters, Fig. 2, are the more available, as they have fine open dials eight inches in diameter, and have special cut out plugs, so they can be left in circuit or not, as desired. They are made to measure currents of any desired quantity, though 500 amperes is the largest size in Queen & Company's catalogues. The smaller ammeters, Fig. 1, are suitable for isolated installations, and are so low in price that they can be economically used on the most inexpensive plants. In marine work, where space is limited, the ammeters and voltmeters must not be affected by proximity to the dynamos or the motion of the vessel. The magnetic vane instruments have been largely used for such work by some of the big construction companies, with most satisfactory results.

The voltmeter, Fig. 3, is intended for electric railway engineering, and will be found a most valuable instrument. It is calibrated up to 600 volts, and has a special short circuit key for rapid work. Queen & Company have just issued circular No. 235, fully describing these instruments.

Electric Lights and the Tunnel.

In reference to the report of the railroad commissioners on the Fourth avenue tunnel accident, secretary Hudson said, at Albany, last week, that the board did not express the opinion that the electric lights in the tunnel would tend to make the signal lights less visible, but that the testimony before the coroner's jury was strongly against the use of electric lights, as it was said that the smoke and steam would simply be illuminated by these lights and danger signals rendered less visible. The board awaits the results of the experiments on the subject in the Fourth avenue tunnel, orders having been given by the companies to string incandescent electric lights in one of the side tunnels on the side opposite the signals, to test the question practically, and also the problem whether electric light will penetrate fog, smoke, etc., farther and clearer than lights now in signal lamps, with the view of substituting electricity for oil in such lamps.

Michiganders Don't Want Electrocution.

A considerable number of members of the Michigan House have suggested to Representative Henze that if he will drop the feature of his capital punishment bill which provides for execution by electricity, they will vote for the restoration of the death penalty and will work heartily to secure the bill's passage. They say that electrocution is still an experiment, that it is costly and they believe that the red-handed murderers should be shuffled off at the least expense to the State possible. For this purpose the gallows is good enough and is the least expensive method of execution. Mr. Henze is willing to return to the rope, if the death penalty can be restored.

Poles and Wires Come Down.

A gang of pole choppers under the direction of a contractor employed by the city, cut down many poles and overhead circuits last week in the streets mentioned in Mayor Grant's list. Where they were able to, the electric light companies worked ahead of the city gang and took down their wires themselves. Cables were run where subways were provided, by gangs of men working all night in some instances. Streets and stores were dark if wires were cut in streets where no subways had been built. An official report showed that on Thursday eight of the Brush Company's poles were cut down in Broome street, and ten of the United States Company's in Leonard and Vandam streets. The poles in Reade street, from Broadway to Centre, where removed before the city's men reached them. About 10,000 feet of wire were secured.

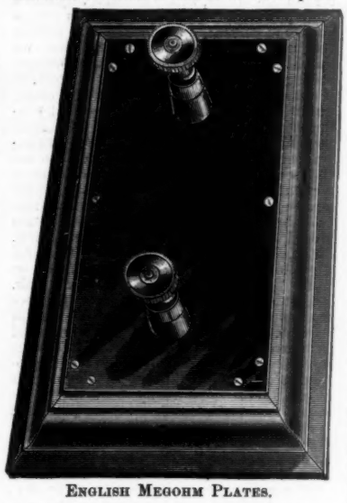
New Engine—New Dynamos.

The Edison Illuminating Company, of Detroit, Mich., have contracted with Fairbanks, Morse & Company, of Chicago, for a 400 horse-power non-condensing tandem compound engine to be built by the John T. Noye Manufacturing Company, of Buffalo, N. Y. This will be an exceptionally fine engine of their "B" type, suitable for heavy duty. It will run two of the new pattern Edison machines, which will be among the first of this size built. The coupling of the engine and dynamos will be a novelty.

English Megohm Plates.

The English megohm plates, which we illustrate on this page, is an instrument of great interest to the electrician. Megohm boxes, made of platinum silver or German silver wire, are so expensive as to be a luxury which few electricians and even laboratories are able to enjoy.

With the electrician, whose duty it is to go about from station to station or from point



ENGLISH MEGOHM PLATES.

to point making tests as and where they may be required, the objection to the megohm box has not been simply that of expense. The question of ready portability has been a factor in deciding against the very high resistance box, notwithstanding its greater usefulness.

Now, however, with the advent of the English megohm plates a thoroughly handy, convenient and reliable megohm resistance is available at a much smaller cost than a one-tenth megohm wire box.

The portability of the megohm plates will be best appreciated upon taking into consideration the measurements and weight of the

FIG. 3.

instrument. It is only nine inches in length by seven in width and, exclusive of the binding posts, two inches in height. The binding posts, however, as is customary, stand two inches above the base of the instrument. The whole weight of the instrument is about three pounds. The plates are mounted in polished mahogany cases with hard rubber tops and convenient binding posts. This instrument is placed upon the market in this country by The E. S. Greeley & Company, of New York.

ELECTRIC LIGHT NEWS

— Waukesha, Wis., is to have electric lights.

— The electric light plant at Morristown, Tenn., is to have its capacity increased by additional machinery.

— Manistee, Mich., electors will vote on the question of appropriating $50,000 for purchasing an electric lighting plant this Spring.

— A report on electric lighting of trains in Germany leads to the conclusion that such lighting must be independent of the locomotive, and that it must be on the accumulator system.

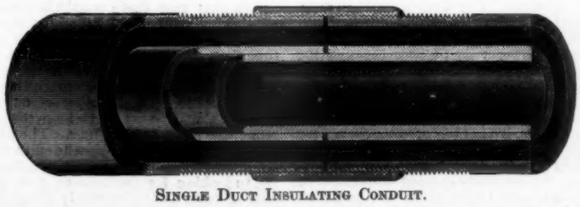
— The Brooklyn Electric Light and Power Company, whose application for a franchise has been buried in the Lamps and Gas Committee of the Brooklyn Board of Aldermen for three years, withdrew that application last week. The concern has been dissolved. At the same time the Montauk Electric Light Company, which is understood to be an outgrowth of the old one, put in an application for a franchise. This was sent to the same committee, and the fun will begin all over again.

A Single Duct Insulating Conduit.

The Interior Conduit & Insulation Company have adapted their well known insulated tubing to fit telescopically into a wrought iron pipe. The full space between the tubing and the iron is filled in with insulating compound; thus all moisture and gases are absolutely shut out. These pipes are made up into ten foot sections ready for shipping, and, when laid, are coupled together by suitable wrought iron couplings. In laying, the sections are converted into a continuous duct having practically no junctions by employing individual insulated tubes whose lengths are the same as the iron pipe sections, but whose external diameter is slightly less than the internal diameter of tube contained in the iron pipe.

These individual tubes are coated at the moment of laying with an insulating compound or cement and telescoped into the iron pipe section to the depth of just one-half their length in each section. A liberal supply of cementing compound is then placed upon each end of the sections to be joined and the ends of the iron pipe brought together firmly by a screw coupling. The insulated iron covered duct thus formed of two complete insulating tubes cemented together and held apart from the iron pipe by a lining of insulating compound, becomes to all intents and purposes as perfect in its continuity as if manufactured in the factory in one unbroken length.

All conduits hitherto employed practically ignore the problem of insulation, thus compelling the use of costly and cumbersome insulations upon the wires themselves, whereas this single duct conduit, as well as the multiple duct system of the same company, provides in the conduit itself, without special investment therefor, an insulation ample for all purposes. They are thus enabled to employ bare copper conductors therein in place of costly and cumbersome insulations and metallic protections heretofore used for underground work. This conduit will be found specially desirable for use of arc lighting companies and others employing a series



SINGLE DUCT INSULATING CONDUIT.

system. It will also be found specially desirable for carrying the feeders of electric street railroad lines; in fact, in any place where a single duct conduit of high insulation is required. By reason of its cheapness and the economy of bare copper wires, it is unnecessary to predict a large and ready market for this conduit.

— The ordinance giving consent to the West Philadelphia Passenger Railway to operate its cars west of the Schuylkill River by the overhead electric wire system, which had passed select council, was passed by the common council of Philadelphia by a vote of 58 to 15.

INDUCTION.

(*Continued from page 99.*)

period, a very rapid pulsating current, and a very strong one, that he does get an electro-magnetic disturbance in this particular case on these short wires.

Mr. Carty: I would like to put it very clearly before the Institute that my experiments refer only to the disturbance which is produced upon one telephone circuit by induction from another, and that in my experiments I have used the human voice for a disturbing source and covered the entire range of telephonic currents. I have also used a musical note. That is, I have had a boy talking and reading. The original experiments at Washington were tried in the switchboard, and we had relays of linemen reading from the newspapers. At New York I used tuning-forks, because they were more economical. (Laughter.)

Mr. William Miner: I would like to ask Mr. Carty if the same result is obtained when the wire that he uses at the top there—L^1—is about three or four times the length of the secondary, and the secondary say a mile in length? The reason I ask this question is, that in the city of Chester, Pa., and about a mile from the exchange, I had called the exchange, when I heard the superintendent at Wilmington, Del., about three miles away, talking with the operator at the Chester exchange; the wires running parallel and both wires grounded. I spoke to the gentleman at Wilmington, and talked with him as well as I ever talked with any one through a telephone.

Mr. Carty: I have never tried that experiment, but I have shown the most favorable conditions for developing an electro-magnetic field around a telephone wire by the human voice, and the conditions which you name will certainly not be as favorable as the case I described. I predict that you would not get any electro magnetic induction between those telephone wires that originated in the transmitter. I would say further that all of my experiments have been reproduced, using condensers, which is an interesting point, and the results from condensers were exactly what I got from straight wires.

Mr. Carty: I wish to point out that there must be some mistake in the reference given by Mr. Lockwood in his note. He says: "Mr. Culley presented a paper once upon this subject before the Society of Telegraph Engineers, which paper, together with a most instructive discussion, is published in the journal of that society, and Mr. Preece and myself from time to time have also repeatedly referred to it." Mr. Culley has not read a paper of any kind before the Society of Telegraph Engineers or Electrical Engineers since 1875. That was before the invention of the telephone. Mr. Culley's paper of 1875 dealt with the induction of telegraph wires. I put in a foot note referring to Mr. Culley's paper in my Electric Club paper. I think that that must be what Mr. Lockwood means. I am very familiar with Mr. Lockwood's writings, but I have never seen anything about that in print. If any one else present has, I think it had better be put on record, as the literature of the subject is meagre at best.

Mr. H. Franklin Watts: I believe it is considered that electro-magnetic induction, pure and simple, is produced by magnetic whirls surrounding the disturbing wire. I would like to ask if it is necessary to have an actual flow of current in the wire in order to produce these magnetic whirls? I am taking it for granted that the magnetic whirls, as I prefer to term them, are the true source of electro-magnetic induction. That being the case, is a wire open at one end capable of producing these whirls? If such a wire is *not* capable of producing whirls, then, in the cases to which Mr. Carty refers, in which the wire is open, it is evident that it is due to something else besides electro-magnetic induction. I am not able to say whether a wire which is merely charged and in which there is no flow of current will produce magnetic whirls or not.

Mr. Carty: I think it must be admitted that in the act of charging the wire a current flows, and even although the end be open that current produces a magnetic field, and all of the effects, while it lasts, that would be produced by a current of the same character flowing in a closed metallic circuit. I think that the same thing would hold true of a current actually passing through the dielectric, until the dielectric is strained to its full limit—that even there it sets up a magnetic field. But in my paper I have endeavored to show, or rather in the discussion, that the current required to charge the wire is so small that the magnetic field produced by it is so slight as to be incapable of causing the ordinary current induction or electro-magnetic induction in the neighboring wire. If the far end of L^1 (Fig. 13) were open, but connected to a condenser of one microfarad, then the effect produced on the secondary wire would be practically just the same as though the wire were grounded by a conductor of small resistance. There is a case where the wire, when measured for its insulation resistance, might have an infinite resistance, and, according to the laws of steady currents, we could not have a current flowing in it; but, when you consider an alternating current, you know that the current flows in dielectrics until the dielectric is sufficiently strained.

Prof. Francis B. Crocker: Mr. President, it appears to me that the question resolves itself into a matter of degree. Mr. Carty states that the ordinary telephone currents, so far as his experiments have gone, fail to show any electro-magnetic effect on each other. Now, he also tells us that under certain conditions, where he had a very much more powerful current with a greater rate of change in current, he succeeded in getting the usual electro-magnetic effect that we should expect, and that by cutting out resistance he increased the effect; whereas, in the case of the telephone current, the cutting out of resistance and inductance actually reduced the effect; showing that the facts were not what we generally expect in electro-magnetic currents. Now, it seems to me that somewhere between these two conditions we must reach a balance point between the electro-magnetic and the electrostatic action; in other words, the electrostatic action would equal the electro-magnetic action. Mr. Kennelly has suggested how to calculate the value of the induction. It could also be easily determined experimentally, I think. Keeping the line lengths and impedance constant, and varying the rate of change of current, and finding when the strength of the current or rather the rate of its change reaches a certain value, at which the electro-magnetic effect is equal to the electrostatic effect, there must really be a limit. As soon as disturbances become audible then they are important. Before that, they are of no importance. Evidently there must be a point somewhere between the two cases given by Mr. Carty at which a sufficiently low impedance, or a sufficiently great electro-magnetic effect would give audible electro-magnetic inductive disturbances. It is evidently a tangible question. Mr. Carty is right in saying that he considers only the ordinary condition of telephone circuits and telephone "cross-talk," and not currents which the ordinary telephone transmitters do not produce. Nevertheless, in order to be sure when the electro magnetic action becomes significant, which might be at a certain current; for example, five times as great as in ordinary telephone circuits, then we should know that ordinary telephone circuits are far below the electro-magnetic disturbance limit that is practically appreciable.

Mr. Francis R. Upton: It seems to me by taking the precautions to do away with the cross-talk, that the magnetic induction that might come on to the circuit would be increased; that where the two go oppositely the precautions which would do away with static induction would increase the magnetic induction; what would do away with the magnetic induction would increase the static induction. What I wish to know is, whether these diagrams show anything that is in actual practice in telephone lines.

Mr. Carty: Five hundred feet was the length of most of the lines used. But all of my practical experience confirms the experiments on these lines, and the system employed to do away with disturbances is effective for both electro-magnetic and electrostatic induction. It is much easier to get rid of electro-magnetic induction than electrostatic induction. In regard to a point being reached where the electro-magnetic induction and the electrostatic induction are neutralized, I would say that I referred to it in the original report which I made on my first experiment—which, by the way, was for the settlement of a practical question involving the payment of a large amount of money—as to whether there was cross-talk or not in a given switchboard. One set of experts would go there and produce what they considered the most favorable conditions for obtaining cross-talk, assuming that it was electro-magnetic. Now, as I have shown, in that case, we would get none at all. So they would go back and report there was no cross-talk. The manager did not know what to do, because he was a witness of the experiment, and he would ascribe it to the weather or some other obscure cause. Another man would go and he might leave some impedance in at the far end of the disturbing wire, and in that case there would be cross-talk. While at Washington I found out what was the matter, and it occurred to me at that time that the two kinds of induction might conflict; that is, that a given impulse which would tend to produce a current in one direction would, in that case, meet one of the electrostatic currents and shove the neutral point one way or the other. The next impulse being in the opposite direction, it would move the neutral point the other way. So, in looking for the balance, you want to bear in mind that the neutral point is shifting back and forth all the time.

The Secretary: Before the discussion closes I wish to say in regard to Mr. Carty's paper that he has taken great pains to place these experiments before us, and it appears to me that he has thrown down the gauntlet to a great many eminent authorities, and he has also been so kind as to prepare his paper in advance, so that all who wished could discuss these experiments and pick any flaws which they might see fit in the arguments that he has advanced. In accordance with his suggestion, Mr. Kennelly was invited to open the discussion, believing him to be well qualified to do so. Now, when a member undertakes to do a thing of this kind, and bring a paper before perhaps the highest electrical body in this country in order to give others a chance to demolish his arguments, I believe he is entitled to the thanks of the Institute, and I, therefore, move that a vote of thanks be tendered to him for his able paper.

The President: It is moved and seconded that a vote of thanks be tendered Mr. Carty for presenting the paper the way he has before the Institute.

The motion was carried and the meeting adjourned.

COMMUNICATED TO THE SECRETARY, AFTER ADJOURNMENT, BY A. E. KENNELLY.

(Note on the relative degree of disturbance caused by electrostatic and electro-magnetic induction between certain simple arrangements of telephone circuits.)

Referring to Fig. 2 of Mr. Carty's paper, let L^1 be a primary line, L^2 and L^3 the lines of a secondary circuit. Suppose, also, to simplify the conditions, that L^2 is so far remote from L^1 and L^3 by comparison with the half inch of distance separating these latter, that all inductive influence on or from L^2 may be omitted from consideration. The most convenient way of dealing with L^2 is to replace it by the ground, and we have then only to consider the two circuits L^1 and L^3, each taken as negligibly small for the case under discussion.

By considering, first, the amount of disturbance that would be statically set up in L^3 if electro magnetic action did not exist; and second, the magnetic disturbance on the hypothesis that no static induction took place, it is possible to form a comparative estimate of the relative proportions of these disturbances, when, as in practice, both influences act together. The result will not be accurate, because the influence of each not only combines with, but also to a certain extent modifies the action of the other, but the discrepancy due to so elementary a treatment will not in all probability invalidate the results as a first approximation.

Let k be the mutual electrostatic capacity of L^1 and L^3 per centimeter length of each in A. E. M. U.

Let μ be the mutual electro-magnetic capacity, or mutual inductance of L^1 and L^3 per cm. of each in A. E. M. U.

Let l be the length of each of the wires in cms.

Let e be the primary circuit E.M.F., which is periodic in value.

Let n be the number of periods completed by e per second.

Let ω^1 be the impedance in the circuit of L^1 in A. E. M. U.

Let ω^3 be the impedance in the circuit of L^3 in A. E. M. U.

Let γ_e be the current in each of the two end telephones of the secondary circuit, owing to electrostatic induction when electro-magnetic induction is supposed to be absent.

Let γ_m be the current in each of three telephones in the secondary circuit (one of the center of L^2 and the other at its ends), when electro-magnetic action is supposed to exist between the circuits to the exclusion of static induction.

Let q be the total electrostatic charge induced on L at any moment by static induction.

Let r be the radius of each wire (copper) in cms.

Let the wires be parallel and the distance between their axes be d cms. in the horizontal plane elevated h cms. above the ground.

Then if the end of L^1 distant from the transmitter be disconnected from the ground and electrostatic influence only be supposed to act upon the secondary circuit, the potential of L^1 at any moment will be e, the value of the periodic E. M. F., while the induced charge upon L^3 will be expressed by

$$q = -e\,l\,k.$$

The flow of current from L^3 to ground will at any moment be the time rate of change in q or, numerically,

$$\frac{dq}{dt} = lk\frac{de}{dt},$$

and since this by symmetry will divide equally between the two end telephones in L^3, the current in each is, numerically,

$$\gamma^e = \frac{lk}{2}\frac{de}{dt}.$$

Now, with electro-magnetic induction, active and static action suspended, the distant end of L^1 is connected to ground through a certain impedance. The current then existing in the primary circuit at any moment is

$$\frac{e}{\omega^1}$$

and in the secondary circuit $\frac{l\mu}{\omega^1}\frac{de}{dt}\cdot\frac{1}{\omega^3} = \gamma_m$

since this affects all three telephones alike.

Since γ_e and γ_m are periodic currents of the same frequency, they will produce equally loud sounds in the telephones when of equal numerical value, and the ratio of static to magnetic disturbance in the two cases will be

$$\frac{\gamma_e}{\gamma_m} = \frac{k\,\omega^1\,\omega^3}{\mu\quad 2}$$

Provided, then, that the impedance of the primary circuit at the receiving end is always large, the ratio of static to magnetic disturbance will be approximately expressed by this equation. In order to apply it to the case of Fig. 2, we have to determine from the geometrical relations of the wires their mutual capacities k and μ.

The value of k in A. E. S. U. has been given by Mr. Oliver Heaviside in the journal of the Society of Electrical Engineers, London, for April, 1881 (with a misprint in the formula here avoided):

$$k = \frac{\frac{1}{4}\log\varepsilon\frac{\sqrt{d^2+4h^2}}{d}}{\left\{\log\varepsilon\frac{2h}{r}\right\}^2 - \left\{\log\varepsilon\frac{\sqrt{d^2+4h^2}}{d}\right\}^2}$$

Substituting for d 1.25 (cms. or half an inch), for h 1000 (cms. or about 33 feet), for r 0.1 (cms. or 0.04" about representing No. 12 B. & S. gauge).

$k = 0.0714$ A. E. S. U. $= 7.94 \times 10^{-22}$ A. E. M. U., or 0.0128 microfarads per mile.

The value for μ can also be found from another formula first published by Mr. Heaviside in the journal of the above mentioned society for May, 1878, namely:

$$\mu = \log\varepsilon\frac{d^2+4h^2}{d^2}$$

from which $\mu = 14.75$ A. E. M. U., or 2.37 millihenrys per mile.

Thus, for equality between γ_e and γ_m we must have, with these values of k and μ,

$$\omega^1\,\omega^3 = 3.717 \times 10^{22} \text{ A. E. M. U.}$$

Three telephones of 75 ω and 90 h each would to a frequency of $n = 435$ corresponding to the note a^1 offer an impedance of $\omega^3 = 7.72 \times 10^{11}$ or 772 ohms, the impedance of the three telephones to this frequency being more than three times their resistance.

For $\gamma_e/\gamma_m = 1$, ω^1 must now be $3.717 \times 10^{22}/7.72 \times 10^{11}$ or 4.816×10^{11} or 481.6 ohms, in round numbers 500, while with the primary circuit of Fig. 2 having a transmitter of 165 ω and 730 h with a call-bell at the distant end of 550 ω and 2.7 H, the total resistance would be 715 ω, the total inductance 3.43 H, and the impedance to the same frequency of $n = 435$ would be $9.40 \times 10^{12} = 9400\ \omega$ or about 13 times greater than the total resistance. The impedance ω^1 is thus nearly 20 times greater than that needed by the formula for equality between γ_e and γ_m and, roughly, the static disturbance in Fig. 2 may be estimated as 20 times greater than the magnetic.

The Edison Electric Drill.

The Edison General Electric Company gave an exhibition of their electric percussion drill recently, at Quincy, Mass., which was attended by a large number of quarry owners from different quarries in Massachusetts, as well as by a large number of mine owners from Boston and Canada. The result of the exhibition was very satisfactory, indeed, and the general opinion expressed by parties well versed in such matters was that the electric percussion drill is far ahead of the steam or compressed air drill. Two steam drills working in the same quarry gave an excellent chance for comparison.

Although the stone in Quincy is exceptionally hard, the electric percussion drill was able to drill a hole one and one-half inch

EDISON ELECTRIC DRILL.

diameter, at an average rate of two and three-quarter inches per minute, with an expenditure of less than four horse-power delivered at the generator. At one time the rate of drilling was as high as four inches per minute.

Among the special features brought out by this exhibition were the extreme ease with which the power could be transmitted to the drill from the generating station, and the great simplicity of the machine itself,

The Stanley Transformer.

We have already mentioned the formation of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., and the connection of Mr. Henry Hine, the experienced electrical engineer, with this company as general manager. The officers of the company are as follows: Charles Atwater, president and treasurer; Henry Hine, general manager; John H. Kelman, superintendent; William Stanley, Jr., electrician. The plant of the company is situated at Pittsfield, Mass., where Mr. Stanley has had his private laboratory for several years. The policy which the new company will pursue is frank, of the most progressive character, and one which if adhered to, as it undoubtedly will be, will certainly lead to success. It is as follows:

1st. In designing its apparatus, to study carefully the needs of operating companies, and make economy and convenience in use the first requisite of any article it manufactures.

2d. To keep abreast of the advance in the art, and bring out from time to time new appliances which operating companies need to increase their profits.

3d. To carefully avoid infringing the rights of others, whether secured by patents or otherwise.

4th. To manufacture as cheaply as possible, and sell at a reasonable price, but, above all, to make every part just as well as it can be made.

5th. To make friends of its customers by adopting and practicing a broad, liberal policy of fair dealing.

6th. To sell only on practically cash terms.

The company will devote its time to the manufacture of comparatively few specialties. The most of these, of course, will be the inventions of Mr. Stanley, whose name and fame are too wide among the electrical fraternity to need any mention here.

Of late, Mr. Stanley's attention has been largely drawn to perfecting the converter or transformer. This device in itself is nothing new, and its principle is comparatively simple, but Mr. Stanley was convinced that the transformer had not yet reached its highest development, either electrical or mechanical. The results of his work in this line are shown in the accompanying illustrations, which give a good idea of the first important piece of apparatus put upon the market by the Stanley Electric Manufacturing Company. In Fig. 1, the transformer is shown complete and in position for service. In Fig. 2, it is shown with the front plate removed and the arrangement of fuses in view. In replacing fuses, the plate is not removed, but the door is opened by loosening the thumb screw.

The claims made for the Stanley transformer are of the highest character, and comparative tests have been made which would seem to put it in the very front rank among these important devices. The factor of safety is brought forward in a prominent way, the insulation used having several times the resisting power to high potential discharges of that commonly used. It is a special preparation developed for this use. The method of winding the coils reduces the chance of a cross between the primary and secondary coils from any cause to a minimum. Special tools have been designed for manufacturing these transformers, and the highest class of workmanship is employed in their construction. Every transformer before being shipped is put through severe tests of a very practical character.

An important point is the ease with which the transformer can be put in place. It is hoisted up by the eye-bolt and hooked over the cross-arm or timber upon which it is to rest. The ends of the supporting hook are sharpened so that they sink into the wood. The transformer then supports its own weight and can be safely secured. The weight of the device is comparatively small.

The arrangement of fuses is unique, as shown in the illustration. The secondary fuse is eliminated entirely. The primary fuse wire is supported by a porcelain block and can be secured in place when held in the hand. To replace a fuse which has burned out, it is only necessary to open the door by turning a thumb screw, remove the plug, insert a new one and shut the door; or, attach a new fuse and replace the same plug. The plugs are of a standard size for transformers up to 160 lights. No screw-drivers or pliers are required in inserting the fuse, and, moreover, the operation consumes a very brief time and is entirely safe.

The sizes of the Stanley transformers run from 5 to 100 lights, and are wound for both 1,000 and 2,000 volts primary, with either 100 or 50 volts secondary. Transformers of a larger size or special design can be made to order.

FIG. 2.—STANLEY TRANSFORMER.—FRONT REMOVED.

Electric Lights in Criminal Cases.

[From the New Orleans *Picayune*.]

The story published yesterday in the *Picayune* in regard to the reported falsifying of the official record of the condition of the electric street-lights in the interest of the accused persons on trial in the Hennessy case shows how complete, far-reaching and powerful was the conspiracy against justice, and how important a place these records may play in criminal cases.

The regulations require the police to make daily reports of the condition of the street lights during each night. The state of the light and the degree of illumination furnished at any particular place at a particular time may have important bearings in criminal cases. In the Hennessy case nearly everything turned upon the condition of the street electric lamps at and near the scene of the murder, and, consequently, upon the ability of witnesses to see and recognize the assassins. The weight of the testimony was that the light was good at the time and place of the murder. The original entry of the official record of the custodian of the light book was that the lights were good, but when the book was examined it was found that the entry had been changed to show that the lights were bad at that time. Fortunately, it is stated that there were duplicate copies of the record, which frustrated the wicked design.

Here is something calculated to enlarge a sense of the power of the conspiracy against justice in this city. No institution, apparently, is sacred from its assaults, no place seems to be impregnable against its attacks, and no record safe from its contaminating touch. Every fresh development in this case shows that.

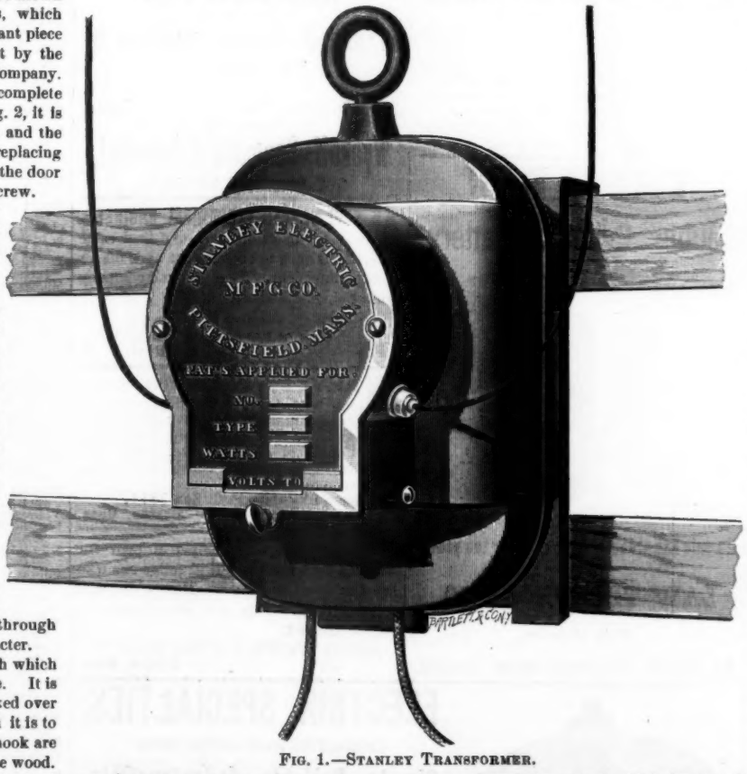


FIG. 1.—STANLEY TRANSFORMER.

VIEWS, NEWS AND INTERVIEWS.

Word comes from Wall street that another big cable deal is close at hand. John W. Mackay's name is mentioned in connection with the scheme. Much quiet work is being done, and no news is cried from the housetops.

That was a daring thief who, a few nights since, climbed to the top of a 250 foot smoke-stack in Providence, R. I., and stole the platinum points which had just been attached to the lightning rods.

The electric time system of Fort Wayne, Ind., was out of kilter for a while last week, owing to the scientific investigations of a precocious messenger boy.

With all of the surface railroads preparing to substitute electricity for horses the prospect of alleviating in some measure the pains and penalties of residence in Brooklyn become brighter.—*Envious Exchange.*

This does not change the fact that some of the most desirable residence property in the world is on Prospect Heights, Brooklyn.

There is a town in Colorado which should receive the attention of some man with a good electrical fire alarm. To be properly attired in that locality one must carry a revolver, consequently the practice is almost universal. When a fire is discovered, every one in sight lets off his gun. The resulting fusillade notifies the fire department that their services are in demand. The great drawback about the scheme, however, is that when the firemen start in the direction of the shooting they are never certain whether they are going to a fire or a fight. They go, just the same, nevertheless.

A Sacramento, Cal., man of the name of Mon. Leak is building a railroad advertising car which will be trailed all over the country. Sample goods will be carried inside and advertising signs outside. A force of men will go along to plaster all the fences, barns and bowlders on the way with bills and signs. The whole outfit is to be brilliantly illuminated with electric lights. The car will make a mighty show bowling along after dark through a farming region. Wonder what the farmers will think it is?

Young Governor Russell, of Massachusetts, accompanied by a retinue of friends, went down to Lynn, last week, and was shown through the Thomson-Houston factories. Governor Russell is progressive and deserves to be commended for wanting to inform himself on a progressive subject—electricity.

The World's Columbian Exposition will afford a splendid opportunity for the display of advertising novelties using the electric light. This is a matter which has not received the attention it merits from inventors and supply companies. There are many places where electric light signs could be made most effective. The new Park Theatre, in this city, is a shining example of what can be done in this line.

The cable tells us that Prof. Tyndall, the eminent English scientist, who, several weeks ago, was reported as suffering from inflammation of the veins, has had a serious relapse. His condition is said to be serious.

Mr. H. L. Shippy, of the John A. Roebling's Sons' Company, takes an especial interest in the complications now existing between the United States and Italian governments. Mr. Shippy's wife and two daughters have been spending the Winter in Italy, and he is naturally anxious as to the outcome of the diplomatic troubles.

South Lakewood Park, N. J., Dr. J. B. De Lery's "Electric City," is enjoying a healthy boom and bids fair to become one of the prominent Winter resorts of America. Lots a few months ago were sold at $150, while now $400 is asked. Improvements are being planned and perfected which will materially enhance the value of property at South Lakewood Park.

KINDRED INTERESTS

George Cutter, Chicago, reports several large orders for Simplex wire. The new insulated rubber screw-drivers are also having a ready sale.

Holmes, Booth & Haydens, Waterbury, Conn., intend shortly to begin the erection of a new wire-drawing mill. The dimensions will be 200x100 feet.

C. R. Vincent & Company have secured contract for complete installation for 500 horse-power steam plant for the West End Street Railroad, Lancaster, Pa.

The Bain Manufacturing Company, 47–49 South Jefferson street, Chicago, have issued a new catalogue describing their motors, dynamos and specialties, and giving many valuable tables and much general information.

The Edison General Electric Company's works at Schenectady, N. Y., will be further enlarged this Spring by the erection of several new buildings. Hundreds of new hands must necessarily be employed. This will give Schenectady a new boom.

Milliken Brothers, 55 Liberty street, New York, have issued a handsome catalogue showing their various types of patented iron poles for street railway and electric lighting work. The book also contains much valuable information for electrical engineers.

The Garvin Machine Company, Laight and Canal streets, New York City, have issued a handy illustrated catalogue of their productions in the machine tool line. The list includes their well known milling machines, drill presses, screw machines, hand lathes, cutter grinders, gear cutting machines and milling machinery.

The Thos. Murray Company, engineers, contractors and builders of electric, steam and tram railways, successors to Thos. Murray & Company, will occupy, after April 1st, 1891, four commodious offices in the new Electrical Exchange Building, corner Liberty and Washington streets, New York City. This company has now under contract 128 miles of electric street railway.

SEALED PROPOSALS.

Sealed proposals will be received by the Electric Light Commission of the city of Wheeling, State of West Virginia, until April 23, 1891, at 12 o'clock noon, for the materials and machinery and the erection of a four hundred (400) arc light electrical street lighting installation for the city of Wheeling, according to plans and specifications on file in the office of the Board of Gas Trustees of said City. Bids to be for the entire plant or for any part thereof, as set forth in said plans and specifications. All bids to be accompanied by a certified check in the sum of one thousand ($1,000) dollars, to the city of Wheeling, to be forfeited to said city upon the failure of the successful bidder to sign the contract and give the bond required.

[Signed] ELECTRIC LIGHT COMMISSION.
P. F. FARRELL, Chairman.
A. A. FRANZHEIM, Secretary.

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ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON MARCH 31, 1891.

449,106 Telephone circuit and apparatus; John J. Carty, New York, N. Y., assignor, by mesne assignments, to the American Bell Telephone Co., Boston, Mass.

449,108 Electric cash indicator and recorder; William F. Z. Desant, New York, N. Y.

449,125 Elastic metallic pole for electric wires; Chas. A. Lieb, New York, N. Y.

449,153 Hanger for electric lamps; Horatio A. Foster, New York, N. Y., assignor to the Thomson-Houston Electric Co. of Connecticut.

449,168 Art of covering electric wires; Thos. W. Norman, Boston, Mass.

449,174 Telegraph transmitter; Harry G. Robbins, Minneapolis, Minn.

449,180 Telephone sound transmitter; Adam E. Schatz, New York, N. Y.

449,186 Thermo-electric battery; John N. Webb, Birmingham, Ala.

449,188 Electric switch; William White, London, England.

449,196 Electric railway conduit. 449,197 Electric motor truck; Francis O. Blackwell, New York, N. Y., assignor to the Thomson-Houston Electric Co. of Connecticut.

449,206 Electro-magnetic device; Moses G. Crane, Newton, Mass.

449,209 Electric fuse; George F. Curtiss, Lynn, Mass., assignor to the Thomson-Houston Electric Co. of Connecticut.

449,226 449,490 Guard for electric railway trolleys; Andrew W. Mitchell, Boston, Mass.

449,227 Electrical railway system; Samuel F. B. Morse, Brooklyn, N. Y.

449,236 449,237 449,238 Electric arc lamp; John H. R. Ward, New York, N. Y., assignor to the Universal Arc Lamp Co., same place.

449,245 Dynamo regulator; Burnett H. Fisher, New York, N. Y.

449,249 Electric cash register system; Robt. E. Nelson, Jr., Columbia, Va.

449,254 Telephone; William Humans, Cambridge, Mass., assignor to the American Magnetic Electric Co., Jersey City, N. J.

449,258 Method of and apparatus for electric soldering; Almon Robinson, Lewiston, Me.

449,266 Hanger-board for electric fixtures; Geo. R. Lean, Boston, Mass., assignor to the Bernstein Electric Co., Portland, Me.

449,282 Electric switch; Horace T. Clark, Bridgeport, Conn.

449,288 Regulating apparatus for electric currents; Wilhelm Lahmeyer, Aix-la-Chapelle, Germany.

449,289 Fuse for electric circuits; Francis W. Maxstadt, Chicago, Ill.

449,299 Galvanic battery; Henry P. Stoecker, New York, N. Y.

449,301 Cut-out; Chas. S. Van Nuis, New Brunswick, N. J.

449,302 Electric contact protector; Richard Varley, Jr., Englewood, N. J.

449,307 Binding post for electric wires; Henry P. Ball, Brooklyn, assignor to the Edison General Electric Co., New York, N. Y.

449,345 Electric belt; Duane P. Andrews, St. Louis, Mo.

449,348 Electric contact; Otis J. Depp, St. Louis, Mo.

449,356 Manufacturing chains by electric welding processes; Elihu Thomson, Lynn, Mass., assignor to the Thomson Electric Welding Co. of Maine.

449,357 Burr preventer for electric welding machines; Elihu Thomson, Swampscott, Mass., assignor to the Thomson Electric Welding Co. of Maine.

449,358 Electro-magnet; Ferdinand A. Wessel, Brooklyn, N. Y.

449,362 Electric switch-box; James H. Dean, Minneapolis, Minn., assignor, by mesne assignments, to Barron D. Southard, same place, and William Perkins, Armada, Mich.

449,375 Pole for electric wires; Julius Meyer, New York, N. Y., and Carl Binder, Chicago, Ill.

449,400 Insulated electric conductor; James D. Bishop, Brooklyn, N. Y.

449,403 Electric lamp reflector; Frank Cooley, Cincinnati, O.

449,404 Electric heating apparatus; Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place.

449,407 Shade for electric lights; James W. Easton, New York, N. Y., assignor to P. Minturn Smith, Plainfield, N. J., and William D. Perry, Brooklyn, N. Y.

449,411 Electric alarm for shaft bearings; Geo. Hannah, Brooklyn, N. Y.

449,468 Automatic electric weighing scale; John V. Davis, Ashland, Ky., assignor to the Automatic Electric Scale Co., same place.

449,474 Electric lighting system; George Gibbs, Milwaukee, Wis.

449,569 Automatic trolley catcher for electric railways; Byron J. Parsons, Omaha, Neb., assignor to Fred. M. Fitch, same place.

449,574 Repeater. 449,575 449,576 Non-interference signal box; Frederick W. Cole, Newton, Mass., assignor of one-half to Moses G. Crane, same place.

449,604 Incandescent electric lamp socket; Franklin A. Weller, Boston, Mass., assignor to Wm. S. Hadaway, Jr., trustee, same place.

449,610 Magnetic separator; Richard R. Moffatt, New York, N. Y., assignor to himself and Sylvester Chichester, Brooklyn, N. Y.

449,611 System of operating electric elevators; William Baxter, Jr., Baltimore County, Md.

449,639 Electric railway signal; Stonewall Tompkins, Knoxville, Tenn., assignor of one-half to Chas. E. Vawter, Crozet, Va.

449,651 Electro-therapeutic syringe; Edwin Bartsch, San Francisco, Cal.

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